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THE PRACTICAL TEACHER

LORD ROSEBERY
AS CHANCELLOR OF LONDON UNIVERSITY.

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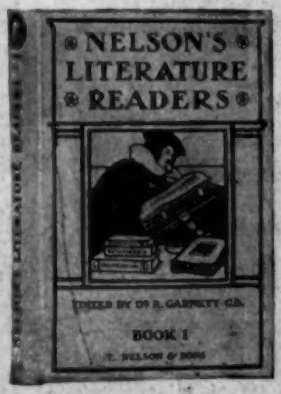

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THE

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A MONTHLY MAGAZINE AND REVIEW

FOR THE SCHOOL-ROOM AND THE STUDY

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EDUCATION IN PARLIAMENT—JUNE-JULY.

AT what age may a child be properly permitted to act in a theatre as fairy, gnome, long-lost heir with a strawberry mark, or premature angel? And up to how late an hour is it healthy and moralising for a child to toil thus in a theatre at night? The law at present answers these questions bluffly and unsentimentally by saying, "At seven years old or upwards," and, "Till the theatre closes, of course." But then, as Mr. Bumble said, the law's a hass, and the effect of new law making is usually to turn it into a compromise, or mule.

The principal educational event in the House of Commons up to July 9th was the further progress of the Employment of Children Bill. The report stage of that measure, which Dr. Macnamara has done so much to call forth, began on the 23rd of June; when, however, the Home Secretary, Mr. Akers-Douglas, rotund and beaming, decided to spoil the Bill so far as it related to the employment of children in places of amusement. What irritated many members about this particular matter was the knowledge that the Home Office was "caving in" to Sir Henry Irving and other eminent theatre-managers who are accepted by the British public as actors.

Mr. Akers-Douglas therefore moved as follows:—"Section 3 of the Prevention of Cruelty to Children Act, 1894 (which regulates the employment of children in public entertainments), shall have effect as if re-enacted in this Act, provided as follows: (1) A license shall not be granted to any child under the age of *nine* years; and (2) any inspector or other officer charged with the execution of this Act shall have and may exercise all the powers of an inspector of factories and workshops under that section."

The meaning of that was to string up the existing law a little and loose down the stringency of the Employment of Children Bill from what it was when it "came downstairs" from the Grand Committee room to the House again. Clause 3 of the Employment of Children Bill, when it left the Grand Committee, provided that no child should be employed (whether in a theatre or elsewhere) after nine o'clock in the evening. The Grand Committee had rejected a clause similar to the one now moved by the Home Secretary, and Messrs. Gray and Macnamara had done excellent work on that Committee in this respect as in others. The House was now asked to do, and compelled to do, what the Committee had deliberately refused to do—namely, allow children henceforth to work or act in theatres after nine o'clock at night.

Sir John Gorst protested; Mr. John Burns protested in the name of the working-classes; Mr. Gray protested in the name of education and the schools the children were supposed to attend the next morning. Mr. Spear, a West Country farmer, ridiculed the idea that a child might not work late sorting fruit in a barn, but might work there late, mumming, if the barn were temporarily a theatre. Dr. Hutchinson protested as a medical man, and Mr. Labouchere as a genial cynic with experience. But it was all no use; the House was cleared for a division; the Government whips "told," and the proposal was carried, and added to the Bill. But only by a very reduced majority of twenty-three.

Thereupon "the general sense of the House of Commons," a delicate instrument which vibrates quickly in response to reductions of majorities, declared for a compromise, and the Home Secretary, while adhering to the late hours in the clause, consented to make the minimum age for employment ten instead of nine; so that the age was formerly seven, the division made it nine, and the compromise made it ten. Thus slowly do the mills of Parliament grind out reform, and grind it "exceedingly small."

On Thursday, July 9, the Education Estimates came again before the House of Commons. The speech in which Sir William Anson recorded the administrative activity of his Department during the past twelve months was long without being tedious, was concise, without a superfluous word, and rose at the end to an inartificial eloquence worthy of the best academical traditions. What he had to reveal was a full statement of careful, tactful, non-partisan rulings, advisings, and achievement with regard to the early operations of the Education Act of 1902. He dealt with some fullness with topics of elementary education, apart from the Act, the training of teachers, the new regulations for the training of pupil teachers, and the physical condition of pupils attending the public elementary schools.

* * *

But it was in that part of his speech which referred to the secondary schools with which the Board of Education has to do that he became most interesting, and indeed produced something of a sensation. Almost "in good set terms" he condemned the kind of education now going on in the grammar schools which are schools in Division B of the Secondary School Code. He pointed to their departure from the type of education they used to give, without their due arrival at a better type; referred to the encouragement of a smattering of science and technology at the expense of languages and literature; and, in short, uttered gently a fulmination which will find many reverberations, and which was hardly fully deserved. The grammar school teachers are not so much in fault as Sir William supposes; what is in fault, Mr. Yoxall told the House, is the policy formulated by Sir John Gorst of encouraging those schools to try to perform two functions, instead of arranging, as they do in Germany, a separate school for a separate type of education.

* * *

Mr. Vicary Gibbs led off an attack on the Board of Education, because of the model bye-law recently issued as permissible for a local education authority to adopt with regard to the hours of closing registers in schools. Mr. Vicary Gibbs, one of the "Church" party, saw in this an encouragement to irreligion; and Dr. Macnamara, while holding that the by-law was justified by sections of the Education Acts of 1870 and 1902, thought that it would come to mean a large withdrawal of children from school during the time not included in the secular two hours. Thereupon Mr. Cripps said that if such was to be the effect, it would be the duty of himself, and of those who thought with him, never to rest until that by-law was repealed; and it became necessary for Mr. Yoxall to explain that the by-law would only be applicable in certain cases, and would not be so formidable a change as had been supposed, though a useful safety-valve where denominational antagonism was rampant.

* * *

Mr. Gray contributed a useful speech to the elucidation of new regulations issued by the Board of Education; and, of course, Sir John Gorst—who now speaks as often as any man in the House almost—had a gird for his successor, as well as a meed of conventional praise. Mr. Hutton was about the first to raise the denominational issue, though later on Mr. Lloyd-George delivered a fiery speech, mainly directed against the Secretary of the Board of Education, Mr. Morant. Against him, also, though in both cases without good reason, Mr. Emmott launched his attack on the causes which led to the resignation of Mr. Sadler of the office of Director of Special Inquiries and Reports.

* * *

Upon the whole, as indeed might have been anticipated, this debate on the Estimates was less useful in detail than many such debates in the past have been. The great question of the working of the Education Act overshadowed everything else, and one must wait for calmer times before the House of Commons can devote itself calmly to details of educational administration that have nothing to do with party politics or theology. No doubt, indeed, the remarks by Sir William Anson on grammar-school work will tend to create even another kind of storm outside.

BY MANY HANDS.

"Quot homines, tot sententiæ."

THE scheme which has been mooted by Lord Rosebery's letter to the press makes one think that at last people at the "Hub of the Empire" are about to wake up to the importance of the position they occupy. There is a spice of truth in the ironical remark of Mr. Chamberlain anent this same letter, to the effect that if Lord Rosebery were to look around England in her provincial and industrial centres, he would find the wherewithal to disabuse himself of any idea of having made a great discovery. Manchester, Birmingham, Bristol, and the great towns of the West Riding have made tremendous efforts in the cause of technological education, and from the very first this side of the work of the northern universities has been prominent. As many of the readers of the *Practical Teacher* know, the Lancashire metropolis possesses one of the very finest of technological institutions, both in building, equipment, staff, and in adaptation to the special needs of the industrial district of which it is the centre. There is a danger of decrying the good work at home in the constant effort to glorify the achievements of our commercial competitor.

The New Scheme for London.

* * *

WE are constantly told to imitate Germany. Well, Germany has imitated us. The commission of inquiry sent out by Mr. Moseley to the United States has been followed by a German commission of forty-seven agriculturists sent out by the Kaiser. The report of the forty-seven affords some surprising tit-bits. The commissioners think very little of American agriculture, and indeed, of America generally. Cigars are too dear, sleeping-car arrangements and negro servants unsatisfactory. But a Berlin University student who was a member of the delegation has left on record the finest gem of the collection—American universities are admirable, in his opinion, *except for the absence of beer-drinking!* Had the student-commissioner come from Heidelberg, the home of the Great Tun, there would

The Inspiration of Beer.

BRITISH MUSEUM

have been a greater fitness in his opinion. But are we then to understand that the source of German educational superiority lies in the greater beer-absorbing powers of its students? University senates and educational authorities will please take notice! And after this we suppose it will be correct to say that the Germans think "small beer" of the Americans.

DOES a big brain mean great mental capacity? The popular belief is that it does, but a connection between size and capacity is very difficult to establish scientifically. A doctor of Prague has been collecting statistics of size, and weighing the brains of all sorts of people, with a view to establishing some connection, if possible, between measurement and power. One list of his conclusions contains some striking statements, and if big brain and big capacity go together, then teachers have reason to be thankful. For at the bottom of Dr. Matiegka's list come labourers, with an average brain-weight of forty-nine ounces; but at the other end are professional men, doctors, and men of university education, with an improvement of five ounces on labourers, their average brain-weight being fifty-four ounces. Put bluntly, this means that the educated brain (other things being equal) is a heavier and better brain than the uneducated one. And if the connection is valid (the *if* is a large one), here you have ready-made one of the most forcible arguments possible in favour of high and prolonged education.

Big Brain—

PRIDE in a big brain is out of place, however. It appears from measurements that the woman of the twentieth century comes *after* the Egyptian woman of the times of the Pharaohs in point of cranial capacity. Does this account for Cleopatra's success, though she was a later specimen? And the biggest-brained man of university education alive has no cause for elation, if it be true that he can show no advance in this respect on the man of the Stone Age! It is humiliating to think that we are in no wise an improvement on the man who lived in a cave and shaved with a flint or an oyster-shell, if size of brain were the true criterion of capacity. But the true criterion will probably be found not in the size of the lump, but in its internal development, especially in the elaboration of the convolutions of the brain. It is in this respect that twentieth-century man can snap his fingers at his neolithic progenitor, and twentieth-century woman smile in a superior way at Pharaoh's daughter.

Big Wit?

There is another point of interest which springs out of Dr. Matiegka's researches—the connection between unfavourable physical conditions and small weight development of the brain. In another form this result has been known to teachers for a long time from woeful experience.

THE publication of the report of the United States Commissioner of Education for 1900–1, causes our friends of the *Revue Pédagogique* to wail mournfully over the difficulties under which the teaching of French now labours. The decisions of the Emperor William regarding the study of English in German secondary schools, where it stands as an option with Greek, and in necessary cases can supplant French, are quoted by the Commissioner with approbation, and are noted by the *Revue Pédagogique* with scathing comments. The recent changes in the programmes for secondary schools in France tend to lessen more and more the study of English, and to replace it by German, thus shutting off more than ever, says our contemporary, the young Frenchman who has passed through one of the great professional schools from relations with Englishmen and Americans. This seems short-sighted; but the woeful tale is not yet complete. Official programmes drawn up by the Board of Education in the United States of America increase the amount of time devoted to German, but lessen that given to French. Here the *Revue* sees a bugbear that periodically haunts the mind of the patriotic Frenchman—the disappearance of the influence of the French language in literature, art, even perhaps in commerce. For a language which a century and a half ago was the language *par excellence*, the spread of English and German is perhaps a matter of soreness, but we think our *confrères* across the Channel are crying "Wolf!" before the time.

A French Wail.

A CURIOUSLY methodical and logical report on the effect of handwriting on the eye comes from Belgium. Put briefly it runs thus:—

1. When we write we look at the pen's point, directing towards it the longitudinal axis of the eyes. We try to place ourselves in such a way that the object is at an equal distance from each eye, forming the apex of an isosceles triangle, of which the line joining the centres of the two eyes forms the base.

2. In writing, the perpendicular raised on this base line corresponds pretty nearly with the direction of the down strokes.

3. By reason of the way in which the motor muscles are disposed about the eyes, the movements made about the vertical or the horizontal axis are less fatiguing than those made about an oblique axis. Wherefore—

> Upright writing, on a book placed squarely, well in front of the writer, in the middle line, is the only writing which conforms to the demands of hygiene.
>
> *Q.E.D.*

Upright Handwriting again.

Another nail in the coffin of the sloping "hand of write" in schools.

N.U.T. NOTES.

"ALL roads lead to Llandudno," runs an advertisement in last month's *Practical Teacher*, issued by the Town Improvement Association of the picturesque North Wales pleasure resort, and it is more than likely that the N.U.T. Conference will hie thither before many years elapse. The Arctic weather experienced at Buxton during Easter week had doubtless a big share in securing the honour of entertaining Conference in 1904 for Portsmouth. Yet the significant fact that 12,548 votes were cast for Llandudno gave Mr. William Tegarty and his colleagues so much encouragement, that they have already forwarded to the Executive a most cordial invitation for Conference in 1905, stating that nothing shall be wanted on the part of the Association to make Conference an unqualified success should the invitation be accepted. Mr. Tegarty is a well-known Conference *habitué*, possessed of an apparently inexhaustible amount of vigour and energy. Times without number has he received the thanks of the Executive for the splendid organising ability he has displayed, and that he would make a

Who says Llandudno?

magnificent Conference secretary goes without saying. He is a speaker of the forcible type, and an altogether delightful host. His personality and his pertinacity will do much towards securing Llandudno's success next year.

* * *

Another "V.-P." Candidate.

"STILL they come" must be written with regard to the aspirants for the vice-presidency of the Union. Six gentlemen have already been mentioned in these columns as candidates for the profession's blue ribbon, and during the past month a seventh has been nominated in the attractive personality of Mr. Arthur Pickles, B.A., the talented chairman of the Education Committee. Mr. Pickles is one of the best speakers we have at Russell Square, and, in addition to wielding a ready and facile pen, has been responsible for the largest reorganisation scheme ever presented to the Union. His perfect mastery of, and apparent propensity for, minutest detail make him an object of wonder and admiration to most of us. The almost enforced withdrawal of Mr. T. H. Jones has rendered the contest singularly open, and this probably explains the phenomenally large number of candidates. Writing nine months before the election takes place makes it a little difficult to forecast the result, though at present I am inclined to think that either Mr. T. P. Sykes or Mr. Tom John will be Mr. Sharples's successor. A poll of 6,000 votes will in all probability be sufficient to secure the victory, and some day the Conference will have to decide between a second ballot and the election of the vice-president by the Executive. For various reasons I personally prefer the latter course.

* * *

Should the Executive choose the "V.-P."?

IN this twentieth century it possibly savours of something akin to high treason to suggest the taking away from the electorate of any of its powers and privileges. Still it may be urged that the position of President of the Union is easily comparable (if one may for the moment compare small things with great) with that of Speaker of the House of Commons. The individual electors choose the members of Parliament, and they in their turn elect the gentleman who is to preside over their deliberations so long as the Parliament endures. Again, the mayor of a municipality is always chosen by the members of the corporation, and not by a poll of the individual ratepayers. With a gigantic constituency like that of England and Wales, stretching from Berwick-on-Tweed to the Land's End, and from Milford to Lowestoft, it is absolutely impossible for the ordinary member of the Union to cast an intelligent vote for the vice-president. On the other hand, the members of the Executive know all the candidates intimately. They see them at their labours almost weekly in the various standing committees and at the Executive meetings. They know their capacity for work, and can sum up with tolerable accuracy their grasp of all educational and professional questions. In a word, they have abundant opportunities for coming to a decision as to who is the veritable "man of the hour." Under the present system there is more than an outside chance of the victory resting with the candidate whose association (or friends) possesses the longest purse. Plenty of advertisements in the columns of the *Schoolmaster* and other educational journals, thousands of circulars issued broadcast over the country, and facilities provided for addressing public and other meetings are the elements which to-day go far to ensure success. It is well known that sums exceeding £150 have during recent years been expended in V.-P. elections—a perfectly wicked waste of money, in my humble judgment. Last year a wise and sensible understanding between those two rivals and good friends, Messrs. Sharples and Jones, did much to bring down the cost to moderate limits, but the evil may resurge at any moment. It has been alleged that, should the power of choosing the vice-president ever devolve on the Executive, there would be a risk of the machinations of coteries and cliques. I, for one, altogether decline to admit its possibility. The members of the Executive are not at all lacking in personal honour, and with a sense of the great responsibility entrusted to them, would, I am convinced, elect *the best man* should the duty ever be delegated to them.

* * *

A "Record"-Breaking Age.

THE most casual newspaper reader cannot but be struck by the rapidity with which new "records" are set up, particularly in the world of sport. In the professional world it is surely a "record" to find that, in three days, a petition was signed by 9,774 out of a total of 10,204 teachers in the Board's employ against the imposition by the London School Board of a particularly obnoxious Report and Records Book. One is almost tempted to inquire: "What ever is the London School Board coming to in its latter days?" Its magnificent educational work for over thirty years has wrung tributes of admiration even from those politicians who are now compassing its destruction. But certain of its administrative acts have during the past year or two been so strange, not to say extraordinary, that service in its schools is not sought after with half the avidity of former times. When I left college, two and twenty years ago, employment under the London Board was in the nature of a student's *summum bonum*. Certainly this is not the case to-day. Its salary scale for class teachers is no better than (if as good as) it was twenty years ago, whilst many of the extra-metropolitan boards provide not only higher minimum salaries, but much more generous annual increments. The attempt to re-impose individual examinations by the Board Inspectors a year ago did a vast amount of harm, and now to-day, Pelion-upon-Ossa like, appears this new Report and Records Book. As an outsider, I don't quite know whether to commiserate with the head or the class teachers the more. The position of both is unenviable in the extreme, and one can but hope that common sense will prevail, and material modifications be made, before the book is introduced into the schools. This particular clause from the head-teacher's annual report on the staff strikes me as particularly anserous—

> "In each column the head-teacher will make an assessment of the work of the assistant-teacher, using the following marks:—Excellent, very good plus, very good, good plus, good, very fair, fair, unsatisfactory."

What a delightful time the head-teachers would have in determining which of these nice distinctions were the most *apropos!* And how the class teachers might suffer from the personal equation of the head teachers! And even the sufferings of both head and class teachers would pale before those of the little ones, for whom under enlightened conditions the London teachers have done their best since the annual parade went by the board.

MR. C. J. CHASE, the Chairman of the Union's Benevolent and Orphan Council, is proving in every way a most fitting successor to Mr. B. South.

The "B. and O." Council.

From an interesting circular letter he has sent out I extract this précis of the decisions of the annual meeting of subscribers, held at Buxton in April last :—

(*a*) Annuities paid to women to be increased from £25 to £30 per annum.

(*b*) Home allowances to be increased from 5s. to 7s. 6d. per week when a child reaches the age of 12.

(*c*) The number of annuities and home allowances to be considerably augmented.

(*d*) "Special grants" paid to orphans to be increased from 2s. 6d. to 3s. 6d. per week.

All the money spent on the above will constitute an annual and permanent charge on the funds, and Mr. Chase shows the extent by which the expenditure of 1902 will be exceeded. Thus—

(*a*) 56 annuities increased by £5 each	= £280.
(*b*) 36 home allowances increased by £6, 10s. each	= £234.
(*c*) 15 additional annuities at £30 each	= £450.
10 additional home allowances at 5s. per week	= £130.
5 additional home allowances at 7s. 6d. per week	= £ 97, 10s.
(*d*) Increase in "special grants" to orphans	= £ 50.
Total.....	£1241, 10s.

Further, Mr. Chase estimates that an additional £350 per annum will be required for the upkeep of the Sydenham and Sheffield Homes, whilst for temporary relief an increased sum of £2,500 will be necessary. The total augmentation is more than £4,000, and the chairman is pardonably anxious that this sum shall be forthcoming. Every one who can should lend a hand in the noble work.

* * *

WITH every confidence the Executive has elected Mr. T. P. Sykes to the important chairmanship of the Tenure Committee, and to say that he will worthily fill the shoes of Mr. T. H. Jones is the highest praise. After a contest, the vice-chairmanship of the committee was bestowed on Mr. G. Hyden, J.P., a north of England representative, who during his brief tenure of office has won golden opinions for the tactful and efficient way in which he has dealt with difficult and delicate cases.

The Tenure Committee.

A. C.

NOTES FROM THE NORTH.

IN succession to Mr. P. Mackinlay, who lately resigned, on account of ill-health, the rectorship of the Edinburgh E.C. Training College, Mr. Alexander Morgan, M.A. (Hons.), D.Sc., has been appointed. The new rector received his early education in Aberdeen, where he afterwards served as a pupil teacher for two years. His professional training was obtained in Edinburgh, at the university of which he secured a number of distinctions. In 1886 he graduated M.A., with first-class honours in mathematics and natural philosophy, and was awarded the Sir David Baxter Scholarship in mathematics and physics. In 1897 he was awarded the degree of D.Sc. Dr. Morgan has been connected with the E.C. Training College since 1886, and during that time, as lecturer in mathematics and science, he has earned the respect of all the students who have passed through that institution. His enthusiasm and zeal for work have made his name. Keenly interested in education, he has made a careful study of the various literatures on the subject, and has at first hand acquainted himself with almost every type of school and training-college in Germany, France, and Switzerland. As the result of these visits, Dr. Morgan published an account of "The Training of Primary and Secondary Teachers in Germany," and a "Report on the Training and Status of Primary and Secondary Teachers in Switzerland," which appeared in Volume VIII. of the Board of Education Special Reports. But, perhaps, to readers of the *Practical Teacher* Dr. Morgan will be better known as the author of important treatises on elementary and advanced physiography. We wish him all success in his new sphere, and have every confidence in his ability to make the Training College a real educational force in Scotland.

New Rector for Edinburgh E.C. Training College.

* * *

DR. DOUGLAS and Professor Jones have referred in their little handbook on Modern Scottish Education to the scant attention paid to Scottish education in Parliament, and to the little time devoted to consideration of the subject, and the recent discussion on the Scottish estimates conclusively prove their contentions. The fact that the time is very near when we shall have another Scottish Education Bill may have in some measure contributed to this result, and also to the rare experience that some English members were found willing to take part in the debate. Certain it is that there was very little in the nature of criticism. The Scottish Education Department goes on its way rejoicing. Circulars and minutes emanate from it in increasing numbers, and Scottish educationists are growing accustomed to their appearance, and Scottish legislators let them pass. The Lord Advocate's speech in introducing the estimates was exceedingly clear and to the point. Having touched on the recent minute granting to small schools greater grants, he referred to the gratifying increase in attendance and school staff. The numbers on the register showed an increase of one thousand on the former year, and this increase, it was noted, was entirely amongst the older scholars, while the numbers under the age of seven had actually decreased. He did not refer to the cause of this, though it is a subject worthy of remark. The cause is clear to those who know schools intimately. It is mainly due to the lack of accommodation. If the pupils of older age remain, there is less room for the younger pupils. The question of the younger pupils will require soon to receive the attention of the Department, or the remedy of raising the age to fourteen will have been in vain, so far as the length a child remains at school is concerned.

Scottish Education in Parliament.

* * *

THE Lord Advocate said that the increased number of children had been met by an increased and more efficient teaching staff, while pupil teachers had actually decreased by 246, and uncertificated teachers had remained practically stationary. The increase in certificated teachers was 256. There is one point in connection with the teaching staff which had so far escaped notice. By the recent minute granting more money to those Boards

Teaching Staff.

which employ additional staff, there will be a decided increase this year in uncertificated teachers. Already many Boards are advertising at £40 and £45 per annum for ex-pupil teachers. There can be little doubt that this will solve the difficulty for training-college accommodation, but will it solve it in the best interests either of education or of the profession? All the pupil teachers who fail to find admission to the training colleges will be able to obtain situations. At present the demand for them is great. Will there not be a danger of these feeling themselves thoroughly satisfied? Will there not be desire on their part to let well alone, and to avoid going on to qualify themselves as certificated teachers? The danger is obvious. The Education Department in giving this additional grant—good in itself—may be simply creating a large and increasing class of uncertificated teachers; so that, instead of two great classes of teachers—the college trained and the university trained—there will be added a third class. The question is worthy the attention of the two great teachers' organisations of Scotland.

* * *

Physical Education.

AS the result of the recent labours of the Commission on Physical Education, considerable attention, both in the House of Lords and the House of Commons, has been given to the question of the feeding and clothing of the poorer children. As Sir John Gorst said, a lurid light had been thrown on the enormous waste of public money which resulted from children being brought into school who were not fit to receive instruction. We have no special plea to offer on behalf of Edinburgh and Aberdeen, whose children come in for such an enormous amount of attention in this connection. But we are convinced that in all the large cities of the United Kingdom much the same condition of matters prevails. If the Commission has done nothing further, it has, in calling attention to this important matter, deserved the thanks of all connected with education. It is impossible to build up and to educate a nation of good citizens if greater care is not given to the all-important factor of health. In the House of Lords, Lord Balfour said that the matter was receiving attention, and that much longer time might be devoted to well-devised physical training, and even to recreation, in the schools than was the case at the present time. How this might be possible was a matter for consideration and inquiry, and he hoped that, before another Code was laid on the table of the House, they should be able to put some conditions into it which would encourage efforts in that direction. The question of the medical inspection of the children at school is one that will perhaps be brought into effect soon. Some of the larger School Boards of Scotland, we understand, are contemplating such a course.

* * *

E.I.S. Doings.

THE General Committee of the Institute had under consideration at its last meeting the question of supplementary courses, and after a long discussion it agreed to the following motions: (1) That the institution of supplementary courses for pupils between the ages of twelve and fourteen is contrary to the recognised educational principle that specialised instruction, to be really effective, must rest on a solid basis of general education; (2) that parents cannot, as a rule, determine the occupation of children only twelve years of age, because (*a*) that is determined as much by opportunity as by choice, and (*b*) the inclinations and aptitude of their children are at that age not fully disclosed; and (3) that the adoption of the rural course in country schools will seriously prejudice the prospects in life of rural pupils, by withholding from them the advantages of a sound general education, which at present they possess in common with town children. This is the answer that the Institute makes to Sir H. Craik's speech at Ayr. The defence of the Secretary for Education has been much commented on in educational circles, and it has been felt that he has considerably weakened his position with regard to Circular 374 by attempting to defend the course on a public platform. At all events there is an undercurrent of hostility to the new departure; at present it may be characterised probably as "passive resistance," and it will depend very largely on the tact and discrimination of H.M. Inspectors as to how these recommendations are carried out whether the hostility will proceed further.

* * *

New Official for the Institute.

IT is felt in many quarters that the time is now ripe for taking definite action with regard to the appointment of a general secretary whose services shall be wholly at the disposal of the Institute. The general committee at its last meeting agreed to recommend to the September meeting that the duties of secretary of the Institute and editor of the *Educational News* should be combined, and that the salary attached to the joint appointment should not be less than £350 per annum. They also recommended that the treasurership of the Institute should be offered to the present secretary, at his present salary of £100 per annum. These recommendations require to be homologated by the annual meeting in September, and no doubt will form the basis of not a little discussion. There are many who think that they will not be carried without much opposition, while there are many who are of opinion that the funds of the Institute cannot stand such a charge on them. Whatever be the result of the annual meeting, it is to be hoped that the matter will receive full and adequate discussion, for the result will perhaps mean that the subject will not again be opened for several years. The changes, if agreed upon, will not take effect till September 1904, though it is expected that efforts will be made to carry them into operation at once. R. G.

WITH OUR CHILDREN.

Our Children in Evidence.

"OUR Children" have been with us to a very remarkable degree recently, so far as legislation and inquiry with a view to legislation are concerned. We need only mention the Education Act for England, the London Bill, the proposed or threatened Bill for Scotland, the Bill to regulate the employment of young persons after school hours, and the Report of the Commission on Physical Training in Scotland, to show how persistently the child has been with us in recent days.

* * *

A Zeal not of Knowledge.

AT the same time, one may be excused for having his doubts as to how far our zeal is with knowledge. In education bills it is notorious that the child is the last thing to be taken into account. He is merely a pawn in the political or other game. Even in our schemes of education—commercial, technical, or other—we do not seem to feel the need of basing the superstructure upon

any known facts regarding the person to be educated, but content ourselves with scheming out the upper stories and piling up materials in the hope that we shall obtain the desired effect in the sky-line somehow. All the more notable on this account is the departure made by the Commission appointed to deal with Physical Training in Scotland.

* * *

THE deplorable physique found to prevail among school children in the poorer districts of Edinburgh seems to have come as a surprise to most people, and the first result will doubtless be to initiate inquiries in other cities in order to discover the extent of our danger from the starvation of children in our slums—a starvation not only or perhaps not chiefly in the matter of food, but in their supply of fresh air, of sunshine, of play, and doubtless in many cases of sufficient sleep. Those who have already given some thought to these matters, including all teachers in the poorer districts of our towns, have little doubt that some terrible discoveries will result from these much-needed inquiries.

City Starvation.

* * *

IN one sense we feel justified in saying that the physical deterioration is even less terrible than the ignorance of it which has up till now prevailed among us. To those whose work lay among those weaklings the fact was sufficiently painful without measuring its extent. Its educational bearings were for the most part lost sight of through the pressure from above applied to the schools to produce certain educational results, which were assumed, empirically and in ignorance, to be the best thing for the children, though the teachers constantly testified that this pressure was not only useless, but in the highest degree cruel and injurious. Such testimony was usually brushed aside as interested, and biassed by the teacher's desire for easier work.

Hitherto Ignored.

* * *

FROM the time of Sir James Crichton-Browne's investigation into over-pressure and the prevalence of school headaches, it has become more common for school authorities to recognise that children have bodies. Something has been done for the worst forms of physical and mental inferiority, but the less prominent types have been consistently ignored. It is only when a child has been classed as exceptional that he has any chance of being treated in accordance with the necessities of his condition. Now we are in a fair way of finding out that the really exceptional child in many quarters is the child who is *not* exceptional in one way or another.

The Exceptional Child.

* * *

THE genesis of this movement strikes us as being very British. It is not due to any logical or scientific process of thought. Military considerations, in the first place, it may fairly be said, suggested the desirability of more regular physical training being given to the boys in our schools. A very natural question was what the result of such training has been where it has been given, and what the physical state of children is in its absence. Such inquiries have revealed a state of things which it was our duty to have known long ago. We have blundered by accident, as we may say, upon a fact which has been staring us in the face for more generations than we care to think of.

An Accidental Discovery.

SO far as yet appears, our cure for this state of things promises to be no less in accordance with our national habits of what we are pleased to call thinking. A scheme of physical exercises for all schools is spoken of as the remedy. It is quite characteristic that we should formulate our remedy before we really investigate the cause of the disease. But drill as a cure for the effects of the complex starvation we spoke of is not a *régime* that we can recommend with any confidence from the standpoint of science or of common sense. Even the making of a soldier does not depend upon military drill alone, but upon military rations and military hygiene as well. In the case of young children we may suspect that the latter factors would be much more powerful than the former.

The Proposed Remedy.

* * *

DURING the dark period of our schools, the age of the "revised code," intellectual welfare was officially assumed to be assured by conformity with the requirements of a carefully-graded scheme of intellectual advance in certain fixed directions. Official assumptions are apt to be more permanent than the officials who give them currency. Teachers need not be surprised, therefore, if a similar assumption is now made and acted on as regards physical improvement in our schools. But in the former case we now know that what was wanted was not mental exercise so much as an opportunity for mental nourishment by the pupils. In the present case a similar principle will be found to apply in the physical sphere.

Official Superstitions.

* * *

THE hopeful thing in the outlook at present is the probability of more thorough inquiry than ever before into the real physical condition of our children. In this inquiry teachers must bear their share. It is a pity that they have not been able to do more pioneer work in this direction than they have accomplished, but now the question has been raised they will surely rise to the occasion. They and their pupils have everything to gain and nothing to lose by such a movement. And once begun, we shall see that it is not a thing that may have a merely temporary vogue, but that it is a necessary part of the teacher's work, and one on which the success of his other work will largely depend.

The Teacher's Responsibility.

MR. T. A. CARTWRIGHT, B.A., B.SC.

WE observe with considerable pleasure that Mr. T. A. Cartwright, B.A., B.Sc., a long-standing and highly-esteemed contributor to these columns, is a candidate for the seat rendered vacant on the Executive of the N.U.T. by the appointment of Mr. T. H. Jones to an inspectorship under the London School Board. Mr. Cartwright should be a highly popular candidate, for he possesses in a high degree all the qualities one associates with the desirable teachers' representative. He is a man of marked intellectual ability and culture; he is a practised writer: he is deeply in earnest; he speaks racily and well from a full mind, and his moral courage and pertinacity are undeniable. Mr. Cartwright will be a distinct acquisition to the Executive; and he should be cordially welcomed by its present members, for he may be relied upon to import more than a spice of humour and vivacity into proceedings which at present, to put it mildly, are not exhilarating. Mr. Cartwright's speech at the Buxton Conference was a capital example of platform ability, and this, coupled with the more sterling qualities so frequently displayed in these columns, should go far to ensure his success. Very cordially and sincerely we wish him well.

THE NEW REGULATIONS FOR THE INSTRUCTION AND TRAINING OF PUPIL TEACHERS AND STUDENTS IN TRAINING COLLEGES.

THE Board of Education has just issued a series of regulations dealing with the question of training teachers. For a long time past those responsible for this work have been kept in a state of great uncertainty through the condition of affairs arising from what is known as the "Cockerton Judgment." By this decision it was declared that the instruction of pupil teachers was not elementary but secondary work, and therefore it was illegal for School Boards to spend the rates in carrying on such work. Notwithstanding instructions and regulations in the Code of the Board of Education, it was found that the legislative enactments did not cover this work. And here it must be pointed out that these "regulations" have no more legal force than the codes which have preceded them. But the law has been altered, and the new educational authorities which have replaced the School Boards now have the control of secondary education, and the training of teachers figures among the duties specifically imposed upon them. This work they may carry out absolutely as they please, but as the necessary funds to cover all education other than elementary will have to come out of the "whiskey money," and a rate not exceeding twopence in the pound, it is not likely that many authorities will attempt to train teachers without accepting the Government grant and complying with these regulations.

We will assume that our readers are fairly conversant with the present system of training teachers, and with the articles in the Code by which that system is regulated. We can best explain the new regulations by comparing them with the old ones. At present, under Article 38, a pupil teacher's engagement may begin either on 1st January or 1st July. Under the new scheme all engagements must begin on the 1st of August and terminate on the 31st of July. This in itself is a great advantage, because it is a help in the direction of getting a uniform school year which shall begin with the reopening of schools after the summer holidays. After the admission of pupil teachers on January 1, 1904, none will be admitted except on 1st August of any year. We are sorry that the regulations do not contain a definite promise that the King's Scholarship Examination shall come at the end of the engagement. We hold that it is very essential that the final examination should come at the termination of the engagement. Why should not the King's Scholarship Examination be held in the middle of July, and the list be published in time to allow the successful candidates to enter college towards the end of September? Apparently the reason is that the papers are marked by the inspectorial staff, and this arrangement would interfere with their holidays. We have no desire to see the inspectors lose a single day of their holidays, but we think that there should be no difficulty in making other arrangements for the marking of the papers which would obviate a very serious inconvenience. Only those who are responsible for the training of pupil teachers know the difficulty of deciding, in the first place, whether a boy or girl shall rush through the work six months before the time supposed to be allotted to the work, or postponing it till six months after, and losing a year in entering college. Then the interval of *nine months* between the examination and the entrance to college is a very grave inconvenience and waste of time, except to the few who can be induced to work for a university examination or some similar definite object.

The actual pupil teachership—that is, the period during which the boy or girl serves in school—is reduced to two years, and cannot be entered before the age of sixteen years, except in the case of rural schools, where the limit will be fifteen. After August 1, 1905, no pupil teacher will be permitted to serve in a public elementary school more than half the time the school is open, and pupil teachers must receive half-time instruction in an approved pupil-teacher centre throughout their engagement. When the distance is great and the facilities for travelling small, the Board of Education will consider alternative proposals, but no evening classes will be permitted without the special sanction of the Board.

To meet the expenses the annual grant will be increased from forty shillings to sixty shillings, and will be paid to the authorities of the centre. This removes an anomaly by which the centre instructs the pupil teacher and the day school gets the grant.

Science and Art grants will be paid on pupil teachers in 1904 as hitherto, but it is proposed to pay an amalgamated grant after that date.

Recognising, apparently, that it will be difficult to recruit if boys and girls are not allowed to become pupil teachers before the age of sixteen, the regulations provide for preparatory classes for intending pupil teachers between the ages of fourteen and sixteen, and an annual grant of £2 will be paid in respect to each member of such a preparatory class. The exact arrangements contemplated for these classes are by no means clear. It is stated that "where a higher elementary school or a suitable secondary school is available, it is desirable that the boys or girls who intend to become pupil teachers should receive their instruction in one or other of those schools. But there will be many places where no such school is available, and where the elementary school cannot provide the instruction required by the more intelligent candidates for pupil teachership. In order to provide for such cases, the new regulations arrange for the creation of full-time preparatory classes, to which boys and girls who intend to become pupil teachers may be admitted between the ages of fourteen and sixteen years. These classes are to be attached to centres, and will provide a course of instruction extending over one or two years, and leading up to the pupil-teacher courses. An annual grant of £2 will be paid for each pupil in the preparatory classes. Such classes may also be conducted in a secondary school, provided that a pupil-teacher centre is attached to the school, and that no grant is claimed under the regulations for secondary schools in respect of pupils in the preparatory classes."

As the Board recognises "that the new requirements, at all events in regard to pupil teachers, represent no more than has been voluntarily undertaken for many years in a number of the larger cities," and states that "in these cases, and doubtless in others, it will be possible to take advantage of the whole of the regulations and of the increased grants without delay," it seems as though the existing pupil-teacher schools are to continue their career of useful work, and will, in fact, work under improved conditions, for they will arrange a four years' course—two years full time and two years half time. Many of them have already been recognised as secondary schools, not only by the Cockerton Judgment, but also by the Board of Education in connection with the Teachers' Register. We presume that under the new authorities they will admit outside students, and thus obviate the objection that pupil teachers never associate with any one else but pupil teachers, and thus the existing centres will rank as secondary schools to which there is a pupil-teacher centre attached.

It is provided in these regulations that the time spent in school *may* be arranged so as to come in a continuous period. We certainly think there is a great advantage in this method, for a pupil teacher will not feel that the work he does in the morning will be undone by the pupil teacher who takes his class in the afternoon, and the head-teacher will be more able to judge his powers and progress in the art of teaching. Perfect freedom is left for the managers to adopt this plan or the half-day plan.

We are sorry to see that Article 42, limiting the number of pupil teachers in a school, is reproduced in these regulations; not that we are anxious to see the market flooded, but because it renders impossible a plan that we certainly think is worth a trial—namely, to provide in each district one or more schools especially adapted for the training of pupil teachers. Many schools offer few facilities for the training, and should have no pupil teachers at all; so without increasing the total number of pupil teachers we might get

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better results. Schools that specialised in this way would take a pride in turning out good teachers, whereas under the present scheme, if a head-master takes pains to train his pupil teachers well, he gets neither credit nor reward.

We are very pleased indeed to see that a conscience clause is introduced into these regulations.

Candidates for admission as pupil teachers must pass either the collective examination of the Board of Education or one of the substitutes at present allowed, or an examination conducted by the Local Authority, or the managers of the pupil-teacher centre, if the Board is satisfied with its adequacy. This is a point that will be welcomed as simplifying the curriculum of centres very considerably.

THE DIRECTOR OF SPECIAL INQUIRIES AND REPORTS.

THE resignation of Mr. Sadler still affords a topic of conversation and comment among educationists, although it is now so distant that it may be discussed calmly and dispassionately, and we cannot help thinking that if the principal actors in the drama had looked at the matter calmly and dispassionately the resignation would never have been sent in. When we first saw the announcement of the resignation in the papers, and read Sir William Anson's reply to Mr. Emmott's question in the House of Commons, we came to the conclusion that the personal element entered very largely into the matter. We have gone carefully into the Blue Book on the subject, and find this opinion strengthened, and cannot help feeling the deepest regret that circumstances should have arisen to stop Mr. Sadler in the course of the admirable work that he was carrying on. Even with the help of the Blue Book, it is impossible to draw up a succinct account of the quarrel—each party seems to accuse the other of the same thing. Mr. Sadler speaks of "the point at issue being proposals which, in his judgment, would impair the scientific value and thoroughness as well as the practical efficiency of the work of his office." Naturally one concludes that such proposals were made by the Board of Education; but the secretary of the Board states categorically that "the Board of Education made no proposals affecting the Department of Special Inquiries, nor did they suggest any departure from the terms of Mr. Acland's minute adopted by the Treasury when the office came into existence, in 1895. Such new proposals as were made, were made by Mr. Sadler, who some weeks ago asked, as a condition of his continuing to hold his post, for an increase in the funds, staff, and accommodation of his branch of the Department, and for a discretion in the use of them so wide as to appear inconsistent with the terms of his appointment.....Mr. Sadler considered that the general inquiries which he might be conducting should take precedence of the immediate wants of the Board if, in his opinion, they were of greater importance."

Dealing with the last point first, we must say that one is led to suppose, by the wording of the statement, that Mr. Sadler had declined to put aside some inquiries he was making on his own lines when asked to make some *special inquiry* by the Board; for when the phrase, "immediate wants of the Board," is contrasted with "the general inquiries," one naturally concludes that the Board wanted an immediate inquiry made into some particular point. But in the whole correspondence published we can find no reference to Mr. Sadler's refusal to take up any work the Board required him to do. The explanation of the phrase seems to be found in Mr. Morant's letter of 9th February 1903 to Mr. Sadler, in which he says, "We cannot admit that your division is entitled to exemption from the demand of the Treasury for economy in all branches of our work, in view of the heavy expenditure arising in connection with the Education Act. .....We understand that you deprecate postponement of any of these reports, and claim that your division should not in any way be affected by the expenditure of other branches of the office." If the "immediate wants of the Board" consisted of money to meet "the expenditure of the other branches of the office," we can understand Mr. Sadler's contention that his own inquiries should have preference; but we think that Sir William Anson should not have used such an equivocal phrase.

With regard to the other points, we regret that space debars us from reproducing the two memoranda (Nos. 38 and 39) in which Mr. Sadler states his case in a masterly manner; but we must content ourselves with a few facts drawn from them. Now, with regard to the expenditure of the Department, Mr. Sadler points out that when the office was established the Treasury sanctioned the expenditure of a total of £3,000 to meet the inclusive cost, whereas the cost has never exceeded £2,000 in any one year. The proposals made by Mr. Sadler we find to be four in number:—

1. Maintenance at their present level of the existing allowances for translation, travelling, etc.

[The statement of this as the first of the requirements seems to confirm our view of the meaning of the phrase "immediate wants of the Board."]

2. An additional allowance of £500 a year to the director, to be spent—(*a*) £350 on skilled assistance;

(*b*) £150 on shorthand and typewriting.

3. Two additional rooms, to provide accommodation for staff and library.

4. Permission to continue the publication of the series of Special Reports.

With regard to the second requirement, we are not familiar with the practice in Government offices, but we certainly think that, as a general principle, it is advisable to leave as little as possible to be disbursed at the discretion of individual officers. The third, we suppose, Mr. Sadler would not have advanced without being able to show the necessity for it, and the Special Reports already published have been so helpful that we certainly think they justify the demand for continuation.

The details of the work are set out, and show that it has been extensive and varied, and that much has been required of the department that was never contemplated by those who established it. For example: "Since October 1901, it has selected teachers of all grades for nomination to the Colonial Office for service in the Transvaal and Orange River Colony. In this work it has dealt personally with between 4,000 and 5,000 separate applications, and has now in its charge the maintenance of a register of nearly a thousand applicants for educational work of all grades in the new South African Colonies."

One point in the memorandum we would specially call attention to in estimating the services that Mr. Sadler has rendered to the country—that is, that he has built up the system of work himself. He did not reap where some one else had sown, for, as he says, "when the Director of Special Inquiries began his work in his new office at Easter 1895, there was no tradition to guide him in his work. He began with nothing but a chair, table, and writing materials."

Mr. Sadler very aptly compares his work with that of the Intelligence Department at the War Office or at the Admiralty. We mean, of course, that he compares the importance of it, not the way in which it has been carried out. Moreover, we are reminded that imitation is the sincerest form of flattery when we read "that the French Government has established an office of Educational Inquiries and Reports, exactly on the model of the English one, in view of the latter's utility and success."

The exact relations between Mr. Sadler and the secretary of the Board also entered into the dispute, and here we think that the differences might easily have been arranged.

For some time after Mr. Sadler announced his resignation many people hoped that the matter might be smoothed over, and that he would resume his old office, but the appointment of a successor showed that such hopes were vain.

The new Director of Special Inquiries and Reports is Dr. H. F. Heath, B.A. of London, and Ph.D. of Strassburg. Dr. Heath is a vigorous and systematic worker, and has done much useful work in reorganising London University, of which he has held the post of Academical Registrar. He is a deep student of English, and takes a keen interest in the teaching of modern languages, having for the last six years edited the quarterly magazine of the Modern Language Association, of which he is one of the founders.

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better results. Schools that specialised in this way would take a pride in turning out good teachers, whereas under the present scheme, if a head-master takes pains to train his pupil teachers well, he gets neither credit nor reward.

We are very pleased indeed to see that a conscience clause is introduced into these regulations.

Candidates for admission as pupil teachers must pass either the collective examination of the Board of Education or one of the substitutes at present allowed, or an examination conducted by the Local Authority, or the managers of the pupil-teacher centre, if the Board is satisfied with its adequacy. This is a point that will be welcomed as simplifying the curriculum of centres very considerably.

THE DIRECTOR OF SPECIAL INQUIRIES AND REPORTS.

THE resignation of Mr. Sadler still affords a topic of conversation and comment among educationists, although it is now so distant that it may be discussed calmly and dispassionately, and we cannot help thinking that if the principal actors in the drama had looked at the matter calmly and dispassionately the resignation would never have been sent in. When we first saw the announcement of the resignation in the papers, and read Sir William Anson's reply to Mr. Emmott's question in the House of Commons, we came to the conclusion that the personal element entered very largely into the matter. We have gone carefully into the Blue Book on the subject, and find this opinion strengthened, and cannot help feeling the deepest regret that circumstances should have arisen to stop Mr. Sadler in the course of the admirable work that he was carrying on. Even with the help of the Blue Book, it is impossible to draw up a succinct account of the quarrel—each party seems to accuse the other of the same thing. Mr. Sadler speaks of "the point at issue being proposals which, in his judgment, would impair the scientific value and thoroughness as well as the practical efficiency of the work of his office." Naturally one concludes that such proposals were made by the Board of Education; but the secretary of the Board states categorically that "the Board of Education made no proposals affecting the Department of Special Inquiries, nor did they suggest any departure from the terms of Mr. Acland's minute adopted by the Treasury when the office came into existence, in 1895. Such new proposals as were made, were made by Mr. Sadler, who some weeks ago asked, as a condition of his continuing to hold his post, for an increase in the funds, staff, and accommodation of his branch of the Department, and for a discretion in the use of them so wide as to appear inconsistent with the terms of his appointment.....Mr. Sadler considered that the general inquiries which he might be conducting should take precedence of the immediate wants of the Board if, in his opinion, they were of greater importance."

Dealing with the last point first, we must say that one is led to suppose, by the wording of the statement, that Mr. Sadler had declined to put aside some inquiries he was making on his own lines when asked to make some *special inquiry* by the Board; for when the phrase, "immediate wants of the Board," is contrasted with "the general inquiries," one naturally concludes that the Board wanted an immediate inquiry made into some particular point. But in the whole correspondence published we can find no reference to Mr. Sadler's refusal to take up any work the Board required him to do. The explanation of the phrase seems to be found in Mr. Morant's letter of 9th February 1903 to Mr. Sadler, in which he says, "We cannot admit that your division is entitled to exemption from the demand of the Treasury for economy in all branches of our work, in view of the heavy expenditure arising in connection with the Education Act. .....We understand that you deprecate postponement of any of these reports, and claim that your division should not in any way be affected by the expenditure of other branches of the office." If the "immediate wants of the Board" consisted of money to meet "the expenditure of the other branches of the office," we can understand Mr. Sadler's contention that his own inquiries should have preference; but we think that Sir William Anson should not have used such an equivocal phrase.

With regard to the other points, we regret that space debars us from reproducing the two memoranda (Nos. 38 and 39) in which Mr. Sadler states his case in a masterly manner; but we must content ourselves with a few facts drawn from them. Now, with regard to the expenditure of the Department, Mr. Sadler points out that when the office was established the Treasury sanctioned the expenditure of a total of £3,000 to meet the inclusive cost, whereas the cost has never exceeded £2,000 in any one year. The proposals made by Mr. Sadler we find to be four in number:—

1. Maintenance at their present level of the existing allowances for translation, travelling, etc.

[The statement of this as the first of the requirements seems to confirm our view of the meaning of the phrase "immediate wants of the Board."]

2. An additional allowance of £500 a year to the director, to be spent—(*a*) £350 on skilled assistance;

(*b*) £150 on shorthand and typewriting.

3. Two additional rooms, to provide accommodation for staff and library.

4. Permission to continue the publication of the series of Special Reports.

With regard to the second requirement, we are not familiar with the practice in Government offices, but we certainly think that, as a general principle, it is advisable to leave as little as possible to be disbursed at the discretion of individual officers. The third, we suppose, Mr. Sadler would not have advanced without being able to show the necessity for it, and the Special Reports already published have been so helpful that we certainly think they justify the demand for continuation.

The details of the work are set out, and show that it has been extensive and varied, and that much has been required of the department that was never contemplated by those who established it. For example: "Since October 1901, it has selected teachers of all grades for nomination to the Colonial Office for service in the Transvaal and Orange River Colony. In this work it has dealt personally with between 4,000 and 5,000 separate applications, and has now in its charge the maintenance of a register of nearly a thousand applicants for educational work of all grades in the new South African Colonies."

One point in the memorandum we would specially call attention to in estimating the services that Mr. Sadler has rendered to the country—that is, that he has built up the system of work himself. He did not reap where some one else had sown, for, as he says, "when the Director of Special Inquiries began his work in his new office at Easter 1895, there was no tradition to guide him in his work. He began with nothing but a chair, table, and writing materials."

Mr. Sadler very aptly compares his work with that of the Intelligence Department at the War Office or at the Admiralty. We mean, of course, that he compares the importance of it, not the way in which it has been carried out. Moreover, we are reminded that imitation is the sincerest form of flattery when we read "that the French Government has established an office of Educational Inquiries and Reports, exactly on the model of the English one, in view of the latter's utility and success."

The exact relations between Mr. Sadler and the secretary of the Board also entered into the dispute, and here we think that the differences might easily have been arranged.

For some time after Mr. Sadler announced his resignation many people hoped that the matter might be smoothed over, and that he would resume his old office, but the appointment of a successor showed that such hopes were vain.

The new Director of Special Inquiries and Reports is Dr. H. F. Heath, B.A. of London, and Ph.D. of Strassburg. Dr. Heath is a vigorous and systematic worker, and has done much useful work in reorganising London University, of which he has held the post of Academical Registrar. He is a deep student of English, and takes a keen interest in the teaching of modern languages, having for the last six years edited the quarterly magazine of the Modern Language Association, of which he is one of the founders.

MUNICIPAL MUSEUMS AND THE ELEMENTARY SCHOOL.

TIME was when the ordinary museum was a wilderness of dry bones, a solitude amidst crowded streets, a place of assignation for lovers, who sat hand in hand amidst dusty fossils and odorous sarcophagi, or whispered soft nothings under the very eyes of defunct mammalia. The ordinary citizen shunned the place, as though it were infected; children regarded it as a ghoulish cemetery, with sesquipedalian epitaphs. If by chance the little ones, greatly daring, did venture within, they marvelled open-mouthed to see a frog labelled *Rana temporaria*, and a minnow, *Leuciscus phoxinus*. Without a guide, philosopher, or friend, they saw nothing worthy of their attention, and departed openly contemptuous. But all this is now changed. In some of our large towns the museum authorities have realised that their collections may be made of direct educational value to the children attending the elementary schools, and that, in fact, in these days of nature study, they are almost a necessity. Amongst such progressive towns we must accord a high place to Liverpool, which has devised methods of not only bringing some of the myriad instructive things which are housed in the museum to the contemplation of the child in the school, but has lured the child in the school to the contemplation of the museum (interior) on Saturdays and half-holidays. How this is being done will interest all practical teachers, and we therefore extract from the fiftieth report of the museum committee the following account:—

"Obviously the two ways of utilising museum collections for school children are (*a*) by bringing the school children to the specimens, and (*b*) by taking the specimens to the school children. In both these directions facilities are granted in the Liverpool museums.

"(*a*) The recognition in the Education Code of time devoted to instruction in museums as school attendance has enabled teachers to bring the scholars in classes to our museums during school hours. Such visits previously had to be done in other than school hours, and consequently were not very frequent. A commodious lecture theatre existing in the building is set apart for their use, to which specimens required for the lessons may be conveyed; or the classes group themselves around certain of the cases, from which the public for the time being are excluded by temporary barriers; or the aquarium is visited, and one or more of the living animals in the tanks forms the subject of the lesson. Occasionally simple demonstrations in popular language are given to them by members of the staff.

"Each teacher, of course, has his own idea of the better way to utilise such visits. The more general and probably more efficient method from an educational standpoint is as follows:—Care is taken not to endeavour to cover too wide a field, and one or two cases, or a group of specimens, is selected which illustrates some important facts in nature. The teacher, or one of the museum staff, gives a brief and simple demonstration, in which these particular facts are emphasised, and the inter-relation between the specimens pointed out. The children, with notebook in hand, are then left to themselves, with the simple instruction to limit themselves to these particular specimens, and to make drawings and notes of any of them. The next day, in school, they are called upon to write a short essay, with the help of their drawings and notes, on their visit to the museum. From inquiries made, the instruction thus imparted is found very satisfactory, and of far greater educational value than is the case when the class wanders indiscriminately through the galleries, with no special object. Every encouragement is given to teachers to make use of the museums in this way, and it is gratifying to record an increasing appreciation of these facilities by the teachers.

"The introductory room to the general collection of animal groups on the upper floor of the recently completed extended galleries is especially suitable for lessons of this character, and has already been made use of on several occasions by the schools. Its arrangement is as follows:—On entrance a case is set out, in which, under a tabular statement that all matter is divisible into inorganic and organic groups, specimens of rocks and animals are shown under these respective heads. Then of the organic group of plants and animals (examples of which are contrasted), taking animals, the chordates or vertebrates are contrasted with invertebrates by typical specimens. Next follows a series of special exhibits, arranged so as to bring before the eye as prominently as possible the comparative characters of the classes of the *Chordata*. In the first case is a series of stuffed specimens—mammal, bird, reptile, amphibian, and fish, etc.—arranged in the order named one below the other. A concise explanatory label is attached, drawing attention to the principal points to observe—that is, the external characters of each (hair, feathers, scales, etc.); modifications of form and structure adapted to different habits of life (legs, wings, webbed feet, swimming tail, etc.). In succeeding cases correspondingly arranged are series of skeletons; bisected skulls and skeletons; dissections of general abdominal viscera; injections showing blood circulations; dissections of nervous systems; models of brains, etc., of each vertebrate type, each series being accompanied by a descriptive label, drawing special attention, in as simple language as possible, to the points of agreement and of contrast. Commencing with the mammalia, its different orders are treated in a similar manner along the opposite side of the room.

"(*b*) The arrangements made for the conveyance of museum specimens to the children may conveniently be divided into two sections—(1) by means of circulating cabinets, containing groups of Natural History or other specimens, which are correlated one with the other, and arranged, as far as possible, so as to convey a definite lesson of educational value—what has been described as a small circulating museum; and (2) the formation of a loan collection, from which specimens are lent out as applied for by the teachers.

"(1) It was in the year 1884 that the Museums Committee first sanctioned the formation of circulating cabinets of Natural History for the use of schools, and in consultation with the School Board and other school managers a working scheme was organised for their periodical circulation.

"The cabinets are of the plainest character, made of deal, strengthened by small black metal clasps, with a hanging down handle on each side, by which they may be conveniently carried in an upright position. The majority measure 17 inches long, 17½ inches high, and 12½ inches deep—a size which is found convenient for most of the specimens. Vertebrates, however, require a larger size, and for them cabinets measuring 32 inches long, 17 inches high, and 16 inches deep are found necessary. Sliding trays with a raised rim fit into grooves fixed on the inner side of the cabinet, and in these trays the specimens are contained in boxes which are of multiple sizes, fitting the trays. When the specimens are such as cannot be handled without fear of damage, they are placed in a glass-topped box; otherwise easy-fitting opaque lids are used, and the specimens may be taken out and handled by the student. The trays are readily drawn out, and the contents of the cabinets may be displayed with great facility. As a rule, only one specimen of a species is contained in each box, and a distinguishing number is placed conspicuously upon it. The specimen boxes are numbered, and their positions in the trays bear corresponding numbers, so as to ensure the return of each specimen to its right box and each box to its right place in the tray after use. A descriptive label accompanies each specimen, and a list of the specimens contained in the cabinet is attached to the lid, with fuller descriptions under numbers corresponding to the numbers on the specimens, and in addition a sentence or two drawing attention to the special character of the cabinet as a whole. The specimens themselves are selected with care, and in no case are inferior or non-typical specimens used, and they are arranged in the cabinet as far as possible to illustrate some definite fact in nature, such as the organic origin of coal, the uses of the animal or its skeleton in the economic world, or examples of the various ways in which shells are manufactured into articles of commerce.

"There are now 25 of these Natural History cabinets in circulation, and 75 schools and institutions are receiving them in rotation. The latter consist of 48 Denominational Schools, 25 Board Schools, and 2 Training Colleges for pupil teachers. For distributional purposes our area is divided into two districts—a north and a south—and the cabinets are distributed each month alternately to the schools in the two districts. The schools are under no expense, both the distribution and the collection being undertaken by the museums. Notice is sent to each school a few days before the delivery of the cabinet, and in the cabinet itself is placed an intimation of the date of collection, so that each school knows how long the cabinet will remain at its disposal.

"A brief account of a few of the subjects and contents of these school cabinets may be of interest.

"In the coal cabinet above referred to (see Fig. 1), the organic origin of coal is demonstrated by specimens of sphagnum (wood fibre or cellulose), peat, lignite, bituminous coal, common coal, and anthracite, arranged in the order mentioned. In addition, there are included specimens of characteristic coal fossils. The cabinet named 'Shells and their Uses' contains specimens

illustrating stages in the manufacture of buttons, knife-handles, etc., together with the shells from which they are taken (see Fig. 2).

"A series of cabinets is arranged so as to exemplify the characters of the principal groups of the animal kingdom. In the 'Star-fish and Sea-urchin' cabinet, a descriptive label draws attention to the essential characters of the group of the *Echinoderma*, with references to the specimens of star-fishes, sea-urchins, and sea-cucumbers contained in the cabinet. The coelenterons, molluscs, insects, crustaceans, fishes, amphibians, reptiles, birds, and mammals are similarly treated. Of the other cabinets, some are of a geological character, illustrating 'Rocks,' 'Polished Stones,' etc.; and others of a botanical character,

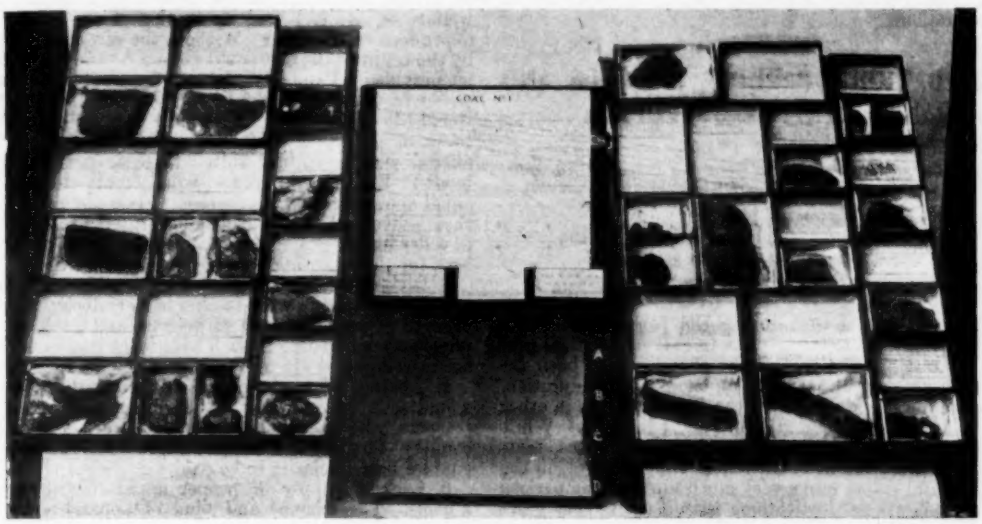


FIG. 1.

illustrating 'Palms and their Uses,' 'Dyes and Tans,' 'Textile Plants,' etc. It is proposed shortly to issue along with each cabinet a type-written or printed description, which will serve as a guide to the teacher in giving lessons on the cabinet to the children.

"(2) The loan collection, from which specimens of Natural History are lent to teachers on application, consists of a series of the commoner types, and has gradually been formed according to the demands made for specimens—any object asked for, if possible, being added from the duplicate specimens of the main collection, if not already in it, so that the character of the loan collection has been brought together entirely by the demand. Typical representatives of the main animal Phyla; the common British species of these groups; comparative series of bird forms, with nests and eggs; insects and their life histories, etc., constitute the greater portion of this collection. Application is made in writing by head masters or mistresses, and the specimens are taken away forthwith by their messenger, if possible, or if not, in the course of a day or two. It is satisfactory to record here also an increasing demand for specimens, and the loan collection has in consequence been considerably enlarged during the last year or two. That these efforts to interest school children in nature study are producing good results is strikingly

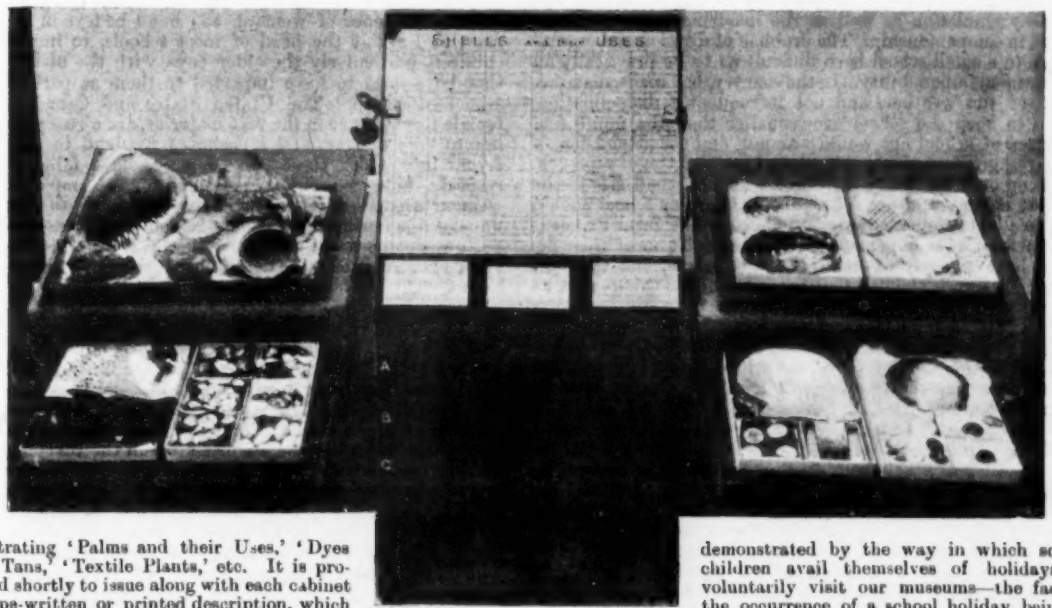


FIG. 2.

demonstrated by the way in which school children avail themselves of holidays to voluntarily visit our museums—the fact of the occurrence of a school holiday being of late always unmistakably indicated by the invasion of the museums by school children, who evince a growing interest in the exhibits.

"All the collections on exhibition have been periodically examined, dusted, and kept free from moth or other pest. The store cabinets and tanks, containing specimens preserved in fluid, have also been systematically gone over for the purpose of

renewing the spirit or other preservative. The store cabinets have also had constant attention, the entomological collections especially requiring frequent examination."

The editor desires to thank the authorities of the Liverpool Museum for their courtesy in providing the photographs for the above illustrations.

CONSOLIDATION OF RURAL SCHOOLS AND TRANSPORTATION OF PUPILS.

BY ALBERT H. LEAKE,

Director of Macdonald Schools for Ontario; Inspector, Ontario Education Department.

"The riches of a commonwealth
Are free, strong minds and hearts of health:
And more to her than gold or grain,
The cunning hand and cultured brain."
WHITTIER.

IT cannot be denied that during the past twenty years great changes have taken place in everything that pertains to education; whether all the changes have been for the better is not equally certain. In one phase of education, progress has not kept pace with the improvements in other directions, and that is the matter of rural education. While improved conditions exist as to teaching, apparatus, textbooks, and to some extent in the school buildings, yet, on the whole, the rural school ranks very much lower in comparison with other educational institutions than it did twenty years ago. "The first thing a good school wants is children." One child teaches another, on the whole, perhaps quite as much as any grown teacher does. In other words, the stimulating, directing, and informing power of a teacher is multiplied two, three, or even four times, to many of the individual pupils, through the passing on, by classmates, of the help the pupils have derived directly from the teacher. It is not only the clever and bright pupils who do this. Every child, in some measure, interprets to its fellow-child some part or some phase of a lesson. It is, almost without exception, true that the very small school is a poor school. There is lacking the feeling of rivalry and friendly emulation as well as the inspiring influence to be found in companionship. The problem of division and organisation in a small school is so difficult as to be practically an educational impossibility. In the country, bad roads, distance, state of the weather, and not infrequently disinclination, serve to keep the school even smaller than the number of children of school age would warrant, and the attendance of the average country school has long been a matter of reproach. Nothing or little can be done in a school of small size in the way of special studies. The purpose of every school should be the adaptation of education to need. The farmer's needs are various, most important, and urgent. To meet them he must have the advantage of the best school, and the best school for him is the one that teaches him the things that he needs to know. As a man and as a citizen his needs are exactly the same as those of other men and other citizens. As an agriculturist his needs have not been so well understood; they are special. I do not wish it to be inferred that I am advocating the teaching of agriculture, and an attempt to train farmers. All I am asking here is that such materials shall be used and such methods adopted as will best accomplish the end in view—the fitting of the boy and the girl for the life that in all probability they will have to lead. The country child has a right to receive an education at least equal to that given to the boy or girl in the large town school. The constant rush of our population into the large towns is a lamentable feature, and something "is rotten in the state of Denmark" when so many of our people are unable to find pleasure in living amidst the natural surroundings of the country. It is time a movement was inaugurated to give greater opportunities, greater pleasure, and greater capacity to enjoy a natural life to the country child, and there is no more fitting place to start this crusade than the country school. This problem of the rural school is not entirely an educational one. Many other features of a social and economic nature enter into it. It is materially connected with the question of good roads. Social relations are widened and extended. Gardens and grounds are improved. Whatever may be said as to the advantages or disadvantages of the country as compared with the city, to the life of the individual, or to the prosperity of the nation, it is certain that the welfare of one is bound up in that of the other. Each is dependent on the other. Without the raw material produced by the country, the city could not exist; and without the outlet provided by the city, the country would lose the motive power for its work. It follows from this that in the educational life of these two allies no difference should be allowed to exist, or rather that each should have those facilities offered which are best suited to their particular requirements. Each should receive equal treatment and be given equal opportunities for progress. From the nature of things these schools cannot be made efficient (efficient not according to codes but according to need) as they are at present organised, for the following reasons:—

1. Lack of time on the part of the teacher. The number of classes to be taken by the teacher of a small school is too great even to be managed well at present, and teaching would be physically impossible if such additional studies and methods are introduced as are necessary to meet the requirements.

2. Absence of teachers with the requisite training. This would soon be remedied if the system were changed. The teachers who are qualified for this work will not take a country school, on account of meagre salaries. Consolidation enables better salaries to be paid.

3. Lack of supply of proper apparatus in the country schools. The amount and kind of apparatus necessary in order to give the kind of instruction needed is much larger than the ordinary school can procure. Libraries, maps, charts, models, natural history collections, school gardens, greenhouses, manual-training rooms, and household-science kitchens are all expensive, and a full equipment in these would involve the expenditure of a much larger sum than the country school, as now organised, can afford, and yet these are necessary adjuncts in the securing of a well-rounded education to fit a boy or a girl for country life.

4. The great majority of rural schools are controlled by women or young girls, and this, when looked at seriously, is pitiful. I believe profoundly in the ability, grace, and refining influence of womanhood; but I believe in having a man, at least at the head of most schools, to impress the children, particularly the older boys, with the many things that boys need to have imparted to them as part of their school education. The United States and Canada, where female teachers are in the vast majority, are already awakening to this danger, and it behoves England to avoid the errors into which these two countries have fallen in this respect. Many reasons are assigned for the employment of women teachers, but the majority only serve to cover the unpalatable truth that the main reason is an economical one.

Now, if it be true that our rural schools are suffering from all or even some of these defects, what can be done to remedy them? The National Educational Association of America in the year 1895 appointed a committee of twelve to consider the whole question of the rural schools. This association is probably the largest and most enthusiastic educational body in the world. Their annual meetings, held in July each year, are in the nature of huge mass meetings, the attendance often running into the tens of thousands. They are so organised and systematised that any teacher is able to obtain from them just what is most profitable in the carrying on of his professional work. Their last annual report is a large bound volume of over one thousand pages. The association now includes eighteen departments, each of which is devoted to a separate phase of educational work. The committee above referred to divided itself into four sub-committees which investigated the problem under the following heads—school maintenance, supervision, supply of teachers, instruction and discipline. These four separate bodies arrived at the same conclusion each from its own standpoint. "The consolidation of those schools which have become so reduced in numbers as to render it unprofitable to maintain them separately, the transportation of pupils at public expense to other schools than their own, and the concentration of higher-grade pupils at a central point are urged as lessening many

of the evi s from which rural schools are suffering. Wherever it has been tried it has commended itself as economical, and as a means of affording better teachers and consequently better schools." These conclusions are now generally accepted in the United States, and the plan is to be tried on a very comprehensive scale in the Dominion of Canada. Now for a brief account of what has been done and the results that have accrued; and here it will be remembered that we are dealing with facts and not theories. The solution of the whole problem of rural education lies in the practicability of the transportation system—that is, conveying the pupils from widely-separated districts to one central school. The feasibility of this is no longer doubted; it is done, and successfully done wherever judiciously tried. Like all other radical reforms, consolidation of schools grew out of the immediate needs of a neighbourhood, or of several neighbourhoods. The town of Concord is generally regarded as the pioneer in this movement. This is a town of 4,000 people, twenty miles north-west of Boston. It was divided, early in the century, int› two village districts and five rural districts. For many years from 1870, the common schools of Concord were twelve in number. These schools were closed and the pupils conveyed to a central school, and the most beneficial results followed. One of the most noted examples of the complete success of this movement is found in Kingsville, Ohio. This experiment was made possible by a special Act of the Legislature passed for the benefit of this one town. The Bill enacted that any township which, by the census of 1890, had a population not less than 1,710 nor more than 1,750 might appropriate funds for the conveyance of pupils in sub-districts. The residents of Kingsville have realised their most sanguine hopes. The average attendance has much increased, and better schools have been provided. Fifty pupils have been conveyed, and the annual cost of tuition has been reduced from $22·75 per pupil to $12·25. The daily attendance has increased from 50 to 90 per cent. Over $1,000 was saved in Kingsville in three years. This law has since been made general in Ohio, and is everywhere proving satisfactory. The county of Madison reports a decrease in the cost of tuition from $16 per year to $10·48 on a basis of total enrolment, and from $26·06 to $16·17 on the basis of average attendance. But from an educational point of view the item of cost is not the most important. The larger and more regular attendance, better school-houses, better teachers, and the greater interest and enthusiasm that numbers bring are most important. In another Ohio place, circles are drawn round the school one mile and two miles distant. Pupils inside the first circle get themselves to school. Pupils between the two circles receive $1 per month, and pupils outside the two circles receive $3 per month, and furnish their own transport. It is not alone in the United States that this consolidation of schools and conveyance of pupils is being inaugurated. As long ago as 1899 two hundred and forty-one schools were closed in Victoria, Australia, and a saving of £14·70 effected yearly by the change. A reasonable excuse for non-attendance in Victoria is that the distance is two miles for a nine-year-old child, two and a half miles for a child from nine to twelve years, and three miles for a child over twelve years of age. In over twenty-one states in the Union is the plan in active and successful operation. Cases similar to those quoted above might be multiplied, but enough have been given to show generally how the plan works as regards the financial aspect of the question. Now some details as to the method of transportation. In those cases where the railway can be utilised this is done, but these are few in number, and for this reason the pupils are generally transported in vans. This part of the scheme requires the most careful consideration, as upon its success the whole plan depends. Tenders for conveyance are asked for, and after reciting and defining the routes the advertisement reads:—

"All whose bids are accepted will be required to sign a contract by which they agree—

"(1) To furnish a suitable vehicle with sufficient seating capacity to convey all the pupils properly belonging to their routes, and acceptable to the committee on transportation.

"(2) To furnish all necessary robes, blankets, etc., to keep the children comfortable, and in severe weather the conveyance must be properly heated with oil-stoves or soapstones.

"(3) To provide a good and reliable team of horses, and a driver who is trustworthy, and who shall have control of all the pupils while under his charge, and shall be responsible for their conduct. Said driver and team to be acceptable to said committee on transportation.

"(4) To deliver the pupils at their respective stations not earlier than 8.30 a.m., nor later than 8.50 a.m., and to leave at 4.5 p.m.

"Each contractor shall give bond for the faithful discharge of his contract in the sum of $100, with sureties approved by the president and clerk of the Board."

In some districts it is provided, between the driver and the Board, that one-half of the previous month's wages shall be retained to ensure the faithful performance of the contract. The contractors are required personally to drive and manage the teams, and to refrain from the use of any profane or vulgar language within the hearing or presence of the pupils, nor may they use tobacco in any form during the time they are conveying the children to and from school. They are not permitted to drive faster than a trot, nor race with any team, and are required to keep order and to report improper conduct on the part of pupils to the principal or the president of the Board. The routes taken by these drivers vary from one to five miles. The following is a brief summary of some things which individual states are doing:—Connecticut in 1899 transported 849 children. They are mostly conveyed the whole distance. They gather at the old schoolhouse or at some convenient point. One town expending $292 effected a saving of $300 per year. Duval Co., Florida, transported 176 pupils at $303 per month, having closed fourteen schools. The saving was $42 per month, and the school work was very much improved. One driver reports that he makes a fifteen mile trip daily and finds no difficulty in managing the children. Four-fifths of a cent per mile is average cost of transportation per pupil. In Massachusetts more than 65 per cent. of the towns and cities have found it necessary and advisable to close and consolidate some schools. The reports from one town show a cost of $46·82 per year for the maintenance of each scholar in the small schools, and of $16·3 per scholar in the central building. In the State of New York eighty-two district schools were extinguished in one year. In 1896 twenty-seven contracts for transportation of pupils were made, and in two years the number exceeded 200. In the State of Iowa consolidation has been tried in twenty-eight counties, transportation in thirty-five, and both in nineteen. From the reports of superintendents of schools in the twenty-one states where the plan is in active operation I gather that the following advantages have unquestionably resulted. If these are not sufficient to convince the most sceptical, a personal comparison and inspection of the old-fashioned rural school and the new consolidated school would turn the most rabid opponent into an enthusiastic supporter.

1. Teachers cost less and are more efficient. These two statements sound paradoxical. No manufacturing business could exist for a year run on the expensive plan of many village schools. Centralisation would provide for perhaps fewer teachers, but they would be better teachers and of more experience. At the present time there are comparatively few, if any, prize places in rural schools. The coveted posts are in the towns and cities. Large central schools in the rural districts would provide what might be called relatively "prize places." The question of the preparation of teachers for the special work required comes in here, and a radical change is required if they are to be equipped for doing the work that is necessary in these schools. With reference to this branch of the subject, it will not be out of place to state what is being done in Canada—that country which is still ignorantly considered by many Englishmen as a backwoods colony. Two teachers of proved ability from each province, with a man in reserve—eleven in all—are now being trained to take charge of these consolidated schools, and five groups of scattered schools. They began with special courses at Chicago University, studying plants, their growth and evolution. At the Agricultural College, Cornell University, they took courses in agriculture, horticulture, dairy husbandry, economic entomology, and agricultural

chemistry. At the Teachers' College, Columbia University, they studied physiology and elementary physics, and attended special lectures on the art of teaching. What is the kind of work these men are expected to do on their return home? Nature study is to be the central point, with manual training and household science treated as of equal importance. A garden will surround every school as its appropriate setting. In addition, on plots ten feet square will be planted wheat, potatoes, clover, and corn, from seed selected and unselected. In 1899 Canadian school children on farms from the Atlantic to the Pacific began sowing oats and wheat from selected seed. In three years the gain was 27 per cent. in the weight of oats and 28 per cent. in the weight of spring wheat, the successful competitors receiving $10 in prizes from the Macdonald Fund. The prize-winners have formed seed-grain associations to raise and supply selected seed of prime quality.

2. Buildings and repairs cost less. The concentration of money and effort upon one serviceable building does away with badly-lighted and poorly-equipped schools. The running expenses are materially decreased, and the buildings can be made an ornament to the district, and more, a centre of influence—educational and social—for the whole district.

3. The value of land will increase. Many families yearly move into cities to educate their children. They would remain upon the farm if they could have within easy reach of their homes a school offering to the children educational advantages equal to those of the town school. The large influx into cities has greatly enhanced the value of real estate in those places, while the increase in value of farm lands has not been nearly so great. In many places where consolidation of school districts has been effected, and a strong central school established, the value of the land has increased very materially, since many parents are desirous that their children should enjoy a good school education without being compelled to give up the farm associations.

4. There is less sickness among children. This plan is more conducive to the preservation of the health of the child. The central buildings are far better adapted for school purposes than the small district schoolhouse. They are properly lighted and provided with modern heating and ventilating appliances, and with the best seating facilities. Where transportation of pupils is provided there is no necessity for travelling through mud or snow for a mile or more to the school, as is often done under the present system. Therefore there will be no wet feet and clothing, and consequent colds with their attendant ills are largely avoided.

5. The school year is lengthened, and regularity and punctuality in attendance increased. The children will be more regular and punctual in attendance, since the larger and better school arouses greater interest. In places where transportation has been tried the attendance has been increased from 50 to 150 per cent. Lateness is practically unknown, since the vans arrive before the time set for the beginning of the session.

6. It leads to better equipment in every way: reference books, charts, apparatus, are provided. All these naturally follow a concentration of wealth and effort, and materially aid in making good schools. Perhaps in the whole educational system there is nothing more pathetic than the equipment of the average village school. Torn maps, dog-eared books, old-fashioned and uncomfortable desks, absence of pictures, etc., and the provision of the smallest amount of illustrative matter possible are the general characteristics.

7. Pupils will make greater progress. While the cities and towns have been perfecting the organisation of their schools, the rural schools have been unable to make the same advances. One teacher cannot very well carry on the work of an entire school, and do justice to the individual pupils or even classes, on account of the number of standards which thorough gradation makes necessary. It is a physical impossibility for one teacher to divide a school into separate grades, and then give each child the amount of time needed for securing the best results. Consolidation gives the country community the many advantages of properly graded schools now enjoyed in towns and cities, without any of the disadvantages. The pupils are taken out of the isolation of the district school and brought in touch with other children, and by this association with their fellows they are broadened and developed. The spirit of emulation in the larger school is greater than in the smaller one, as the pupils have an opportunity to measure themselves with others of their own age.

8. The curriculum can be broadened and extended. In the rural school, owing to want of time, scarcity of qualified teachers, and poor equipment, little has been done to provide real nature study, manual training, or household science, but under a consolidated system much might be done in these directions. The notion has been spread by the catchy sound of the "three R's" that these are still the most important parts of an elementary school course. Many errors are wrapped in catchy or high-sounding phrases. The three H's are at least of equal importance—the hands, the head, and the heart—and their training into intelligence, ability, and unselfish service. It is the duty and privilege of the teacher to guide and train the pupil to apply his new knowledge to the doing of something which the pupils know to be useful and beautiful.

9. There are some outgrowths of a well-organised central school not directly educational. First, good roads. Improvement in this respect is not so imperative in England as it is in the United States and in Canada, but even in England I think that I can remember some roads that are not beyond improvement. It makes a great difference to the farmer whether he can travel ten miles in one hour or in three, or whether his team can draw two tons or half a ton. Good roads mean accessibility, and upon accessibility depends the value of the farm. The intellectual, moral, and religious condition of the rural districts is intimately associated with the state of the country roads. From every district indications are strong that the improvement of the roads is a concomitant of consolidation. Facilities would also be offered for the establishment of local industries. A brilliant example of this is the "Roycrofters." This association has been formed in the village of East Aurora, N.Y.—a village of no importance until this industry (bookbinding) was established there and gave it fame. The company states: "Our business is simply to give artistic employment to the people in the village or the immediate vicinity, and if possible show them that the country is just as desirable a place to live in as the cities." One who has visited this industry writes as follows: "You are here enacting a perfect poem of labour, dedicated to the muses of beauty and health. A rare happiness and serenity result from this linking of day to day with enforced and gracious industry. Joy is lyric. The workman who sings at his bench is doing his work well. In the midst of a material civilisation that subordinates the true nobility of life, of a headlong race for wealth that grinds the faces of the poor, you are favoured to set here in an idyllic frame the picture of an antique simplicity. Let the world roar at a safe distance—here in this quiet and sheltered haven you are doing a task, made possible by the genius of one man, that is of vastly more import than all the shouting yonder. You are as a voice crying in the wilderness—preaching the gospel, I would say, of content with fair and ordered industry, as against the frantic body and soul-destroying slavery that is miscalled labour elsewhere, inculcating by your modest example the preciousness of good living, the conservation of mental and spiritual health." A school uniting and drawing out the special gifts of many who are all unconscious of their powers and of the opportunity that is ready for the skilled hand would be a godsend in many ways besides those indicated in the curriculum of study.

Having given the advantages that have been found to accrue, let us look on the other side of the picture and state the objections that are urged against the plan. These are:—

1. Bad roads and irregular distribution of public highways. As has been said, this can hardly apply in England; but even if it did, it could hardly be considered as a serious obstacle, as their improvement is necessary to the true growth and civilisation of the country and the proper distribution of the population.

2. Uncertainty about expense. This is the point that the public will consider most, and fortunately in this case economy and efficiency go hand in hand. We all long for the time to arrive when educational problems will receive

fair consideration strictly on their merits, and not be rejected, as is the case in many instances now, on the score of expense. Belief in education, despite all the platform oratory, is still, with many, nothing but a pious opinion.

3. Fear that the land on the border of the enlarged district will depreciate in value. This has never yet been the case, but the contrary. It is reported in the eastern states that when a farm is advertised for sale the advertisement points out that the children are transported to a first-class central school instead of offering, as an inducement, that the district school is within a mile of the farm.

4. Many teachers would be thrown out of employment. This argument is not worthy of serious consideration, and will only be advanced by incompetent teachers who are aware they are not qualified for the new positions. In any case, I am much inclined to think that if this result did follow, it would be beneficial rather than the reverse.

These, as far as I can gather, are the main reasons that have been advanced against the adoption of the plan suggested. The changes that are necessary in the school course are to be made not so much by a change of curriculum as by a change in the method of treating the various subjects. For instance, let a pupil plant ten grains of wheat in one row, ten seeds of potatoes in another row, and ten seeds of clover in another row. Let him pull up one plant of each row every week and find out for himself, under the guidance of a competent teacher, what had happened in the meantime. Further, as he was able, let him make drawings of the plot of ground and of the plants, and a written statement of the progress and growth, as he was able to observe it each week. If, then, his lessons in reading, writing, and arithmetic should have a direct bearing upon this nature-study work, would not such a course give an intelligent boy or girl a great amount of exceedingly valuable education? Intelligent purpose put beneath those exercises would help to make progress. One can readily understand how a composition exercise describing a plot of ground, the appearance of a plant, the behaviour of an animal, would be far better written than one which had been produced mainly by ability to remember words or phrases read from a book. Nature study is not to be confounded with systematic teaching of agriculture; it is, in fact, a very different thing. It deals, however, with elementary facts and principles to be discovered in the natural world, and on which the study of agriculture should be based, and is therefore in a large measure a preparation for the study in later years.

Concerning the advantages of rural training, the words of Francis W. Parker, one of America's foremost educators, are well worth quoting: "No method, no system of schools, no enrichment of courses of study, not even the most successful of teaching, can ever take the place in fundamental education of the farm and the workshop. No matter how good the city schools may be, the vital reinforcements of city life that lead to progress must always come from the sturdy stock of the farm. This fact, upon which most educators agree, puts upon the country school an immense responsibility. The country school should make farm labour and all labour honourable, should show that the environment of the country furnishes inexhaustible resources for intellectual life, that the child brings a loving heart to nature; that the so-called practical things of life should have their highest outcome in the cultivation of the love of the beautiful."

PRESENTATION DAY AT LONDON UNIVERSITY.

PRESENTATION DAY this year was of more than ordinary interest, owing to the fact that for the first time in the history of the University some honorary degrees were conferred. Up to this year no one has received a degree from London University without passing the required examinations, and hence a London degree has very great value, as marking high scholarly attainments. On this account many of the graduates heard, not without a good deal of fear for the value of their degrees, that the new charter empowered the University to confer degrees *honoris causa*. But although they may have objected to the principle, they can have felt no objection to the four illustrious persons to whom that principle was applied. It may have seemed somewhat hard on the recipients of the ordinary degrees this year that the ceremony of their presentation should have been obscured by the splendour of that of the four honorary degrees, and perhaps it would have been more satisfactory had the two functions been kept quite distinct.

Such was the number of those who were anxious to see the degrees conferred on the Prince and Princess of Wales, and on Lord Kelvin and Lord Lister, that it was necessary to hold the meeting in the Royal Albert Hall. The Vice-Chancellor (Dr. Pye-Smith, M.D., F.R.S.), in presenting his Royal Highness to the Chancellor (Lord Rosebery), said,—

"Born to greatness, he has achieved it by the narrow and tiresome path of duty. He has seen many cities and many men; and when, with his royal consort, he made the circuit of the globe, he saw none but loyal supporters of his father's throne, and helped to bind, by indissoluble links, this sceptred isle to her most distant offspring."

And in presenting the Princess, he made the equally happy remarks:—

"This University was the first to open her doors to the fairer and the better half of mankind. It is, therefore, fitting that one of our honorary degrees should be given to an illustrious lady, who has the art of winning loyalty and love, in whose life is the law of kindness, who has the *scientia scientiarum*, which is wisdom, and the sympathy which is half the art of healing.

"But all these gifts are united in harmony, and it is therefore for a degree in music that I present her Royal Highness the Princess of Wales."

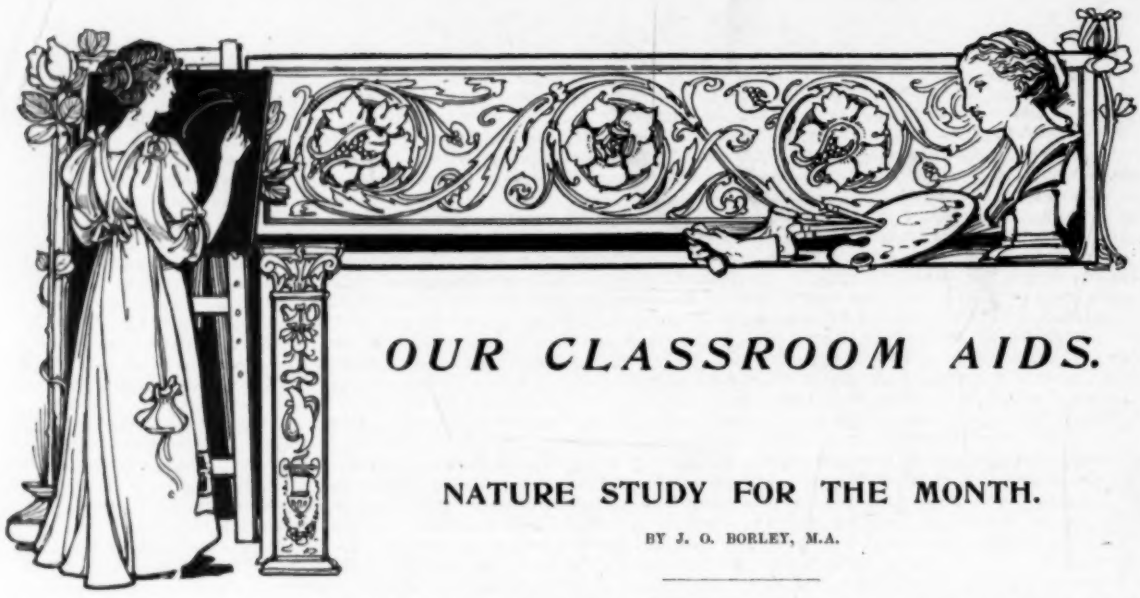
Lord Kelvin was then presented for the honorary degree of Doctor of Science by Professor Tilden, who thus summarised his great work:—

"The illustrious son of a family famous for mathematical talent, for more than half a century Lord Kelvin filled the office of Professor of Natural Philosophy in the ancient University of Glasgow. Two generations have passed since he entered on his professorship, and the advances in physical science which have distinguished the nineteenth century from all preceding epochs have been largely due to the influence of Lord Kelvin in promoting true ideas concerning the conservation of energy, the laws of thermodynamics, and their application to the mechanics and physics of the universe. His untiring intellectual activity has led him also to inquire into problems interesting to the chemist and geologist, as well as those which are important to the physicist and engineer. He has calculated the probable size of atoms; he has studied the structure of crystals; he has estimated the age of the earth.

"But the world knows him best as the man who has shown how practically to measure electrical and magnetic quantities, and has made it possible to link together distant continents by the electric telegraph. It is he who has shown how to neutralise the effects of iron on the compasses of ships, and how to predict the tides, and who has thus taught the mariner to steer safely over the surface of the ocean, and to sound, as he goes, its depths and shallows."

Lord Lister was then presented for the Honorary Degree of Doctor of Science by the Dean of the Faculty of Medicine, who spoke in appropriate terms of the vast service rendered to surgery by Lord Lister, in the introduction of antiseptic treatment in surgical operations, and ventured to predict that the name of Lord Lister will be handed down from generation to generation, until he will be acknowledged by our descendants as the father of surgery, in like manner as Hippocrates is regarded by this present generation as the father of medicine.

The graduates present evidently felt greatly relieved when the Chancellor assured them that the privilege of conferring honorary degrees would be very sparingly exercised, and "that it will not be the task of the University at recurring periods to find persons worthy to receive its honorary degrees, and that it shall only be persons worthy to stand on the same plane with our doctors of to-night whom we shall ever summon to this dais to receive these degrees in future."



OUR CLASSROOM AIDS.

NATURE STUDY FOR THE MONTH.

BY J. O. BORLEY, M.A.

AS during the time that this month's *Practical Teacher* will be current many of us will be at the seaside, it may prove useful to say a few words about the collection of sea forms of life. There is such a wealth of different forms in the space between tide-marks in most places a little removed from a town, that it is of course impossible to mention more than a few of the commonest forms; and as our last and present study has been that of insects, it is suggested that as many as possible of the forms brought home preserved should be those of segmented animals, with more or less hard shells. Crabs, lobsters, prawns, shrimps, and sand-hoppers are the commonest, and it is often easy to procure quite enough of these to form material for a class.

Of course, among crabs the common green crab (*Carcinus mœnas*) should be taken, being abundant and unsought by fishermen. They are present wherever offal is thrown from fishing-smacks or wharves, and can easily be obtained by a net let down in a harbour and baited with fish or meat. Any one who has seen a small trawl net brought up from a much-used harbour, such as the Catwater at Plymouth, feels inclined to think the harbour bottom paved with *Carcinus*. In taking *Carcinus*, see that a few have an orange-coloured bag-like body beneath the "tail" that is turned in under the body. An examination of a fisherman's trawl, taken up from fairly shallow water, or the use of a small iron-mouthed net trawled from a rowing-boat a little way out, will generally add other kinds of crabs to the collection—for instance, reddish triangular crabs of thin shells, covered with curved hairs, and small-bodied, long-legged "spider crabs." A few small lobsters should be taken. They can be caught by means of lobster-pots baited with bad fish, and in the pots there will generally be a good sprinkling of whelks and other molluscs, and hermit crabs in whelk shells. These, especially the last, will be very useful.

Shrimps can be taken easily with a net—along the margin of the sea on a sandy bottom by a small shrimping-net pushed along with its lower bar on or near the bottom, or by a small net for one hand in sand-bottomed tide pools. Notice their semi-transparency, sandlike colour, darting movements, and especially their habit of scuffling down into the sand till their back only is visible.

Sand-hoppers of various sorts can be obtained by searching a sand beach just at the margin of the rising tide. They mostly live on the various worms that burrow into the sand. They look not unlike shrimps, but have not the lobster-like head of shrimps; the front part of the body tapers, but ends with squarish, small segments, not with a long shield for head. A gradual sandy shore is useful for collecting, if not much disturbed: Colwyn Bay is an instance of a good sandy shore. Sudden sandy shores are bad. The shifting, scouring nature of the bottom renders it an impossible home for any creatures but those that burrow into it wholly or partly, and perhaps a sudden sand margin buries these too deeply or capriciously. A pebble shore is practically hopeless for shore collection, and a rock shore is the best for clinging creatures and for miscellaneous living things.

Rocky coasts allow of pools being left by the tides, and these are splendid hunting-grounds. In searching these wading is sure to be necessary, and a pair of old thin rubber-soled tennis shoes are useful, to protect the feet from the sharp points of the limpets. A hooked stick and a net of small meshed netting or muslin is useful for searching under the seaweed of rock pools—and (especially as rocky coasts are frequently steep, causing rapid tide-rise) an eye must always be kept on the position of the shore and on the tides.

Excepting shrimps, and like forms, which lurk under the seaweed and half buried in any sand there may be, the dominant note of the life between tide-marks in rocky districts is security by adhesion. To lose one's hold in this district of currents and buffetings is likely enough to end in being dashed to pieces, or washed out to drown or starve in the deeper water; for many of the shore dwellers drown fairly easily, the winkles among them. The limpet that makes itself so aggressively obvious to the shore collector by its sharp hard shell is typical of this tendency. Collect a few limpets, catching them in the act of moving; also as many different *coloured* specimens of winkles as possible. It would be well to collect, say, ten or twenty yellow ones, the same number of orange or brown, and the same number of slate coloured specimens, all small, and then, if possible, repeat this with large specimens.

Collect a few anemones, carrying an old knife to slide under them and carefully loosen them from the rocks. It is well always to carry two or three large jam-jars, each with a string loop to the neck. Put any "finds" in these pots; three parts fill with sea-water and a little seaweed; renew the water as frequently as possible; stand the jars as often as possible in a pool, and never in the sun. By this means many of the creatures can be taken home to study, alive. It is only the sea-anemones, however, that can be easily kept in aquaria away from the sea.

The best killing agent is a strong solution of corrosive sublimate, a dangerous poison, of course, to be kept locked up. Whelks, winkles, etc., if put in a basin of sea-water, do not always have the consideration to emerge from their shells and crawl for our delectation. They can be made to do so by putting a very little alcohol in the water—a few drops only. By slowly increasing the amount after the emergence occurs, the creature can be drugged, and dies extended; or as soon as well out, it can be quickly snatched out and dropped into the sublimate solution previously placed near. It is very advisable to carry home not mere shells, but shells with their owners displayed. Wash well, and then put into half spirit, half water. Change this fluid every two or three

days till it ceases to become cloudy; then replace by rather stronger spirit, cork up, and tie down the cork. Spirit will not take the colour out of some specimens for some time, but is sure to do so in the end. Any very beautiful things, or a single specimen of crab, etc, might be preserved in formalin (formic aldehyde). This should be kept in a wide-mouthed, stoppered bottle, as the fumes are unpleasant and bad for the eyes. It keeps the natural colours splendidly—at least for a year or so.

Those who are inland will find it more difficult to obtain segmented water-creatures, but should endeavour to get crayfish (like little olive-green lobsters) and fresh-water shrimps (semi-transparent and without the lobster-like head of sea shrimps). The crayfish lurk in holes in the bank.

Next month it is proposed to deal with at least some of the segmented forms mentioned above.

Comparative Study of Insects.

Having studied the metamorphosis which all insects more or less exhibit, let us go on to study their anatomy by comparing the same organ throughout typical members of the class.

Insects have been seen to be animals with ringed or segmented bodies, the bodies further divided into three compartments by two constrictions, the middle compartment bearing six paired legs. Any creature, such as the spider, caterpillar, concentrated, most efficiently serves its purpose when placed on a narrow stalk. Moreover, as the skin of this stalk must be pliable and fairly soft, it is in most cases (practically in all but the wasp and ant) fitted fairly closely to the thorax. The division between the thorax and abdomen is more recondite. It is to be noted, however, that the thorax is the headquarters of locomotion, the abdomen of digestion and reproduction. Now, insects resemble in their ringed or segmented structure many other animals, such as centipeds, which have legs from head to tail. It is therefore, one may assume, a movement of centralisation to confine the legs to three segments; and the ants, bees, and wasps, which have made the waist as small almost as the neck, are precisely those insects which by organisation in societies, and actions one can really hardly avoid calling mental, show themselves the most developed members of the class, the heirs of the ages of insect experience. One can only assume in some vague way it has been found a more economical arrangement to partition off the parts used in different functions. How completely the abdomen is destitute of any importance but for its special work is seen by the fact that wasps have been seen to eat some syrup composedly though they had lost the abdomen, and the syrup merely passed through the head and thorax and again left the body.

It will be noted that the legs of many insects are covered with hairs or spines. This is a rather remarkable fact, con-

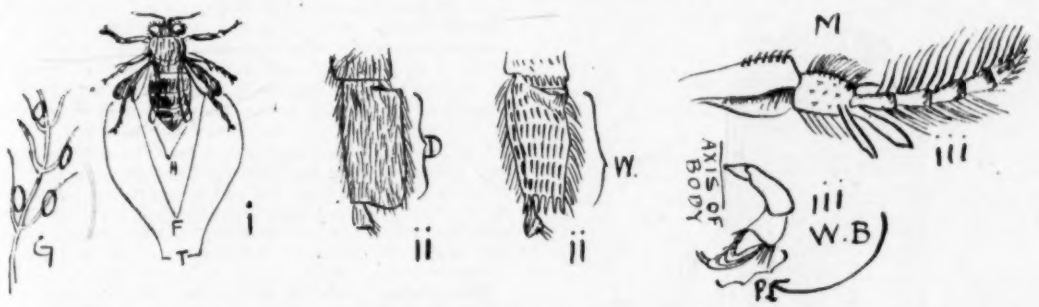


Fig. 1.—i. Rough Sketch of Worker Bee of Apis Mellifica. T, The expanded joints of leg, forming pollen plates. H, Hind wings folded. F, Fore wings folded. G, Single hair from leg, bearing pollen grains, magnified. ii. Second Joint of Foot of Honey Bee, Inner Surface. D, That of drone, with irregular hairs. W, That of worker, with combilike hairs. iii. Feet of Water Beetle. M, That of great water beetle, movable parts only shown. WB, Leg of whirligig beetle. P, The foot, consisting of overlapping plates, which on a stroke, in direction shown, fan out, owing to the resistance of the water, and increase the area of paddle.

not conforming to these conditions, is not an insect. Let us take these features successively.

The most obvious one of them is the threefold division. In order to study this, procure a cockchafer or other fairly large beetle, a grasshopper, a cockroach (or "blackbeetle," not really a beetle, but related to the grasshoppers), a butterfly, a bee, a wasp—in fact, as many kinds of insects as possible, but including necessarily a wasp or ant, a grasshopper or cockroach, and a fly or bee. The division will be seen to vary greatly in its perfection. In the grasshopper there is but little constriction, in the moth rather more, in the fly or bee more, in the ant or wasp what seems a dangerous approach to completion.

What the meaning of the plan is it is imposaible to say completely. Certain facts are, however, obvious. Firstly, in all cases, the parts are different in function and character, all having the sense organs and mouth in the first part, the legs and wings in the second, no important appendages but those used in egg-laying (such as the forceps-like termination of the grasshopper) in the third. Secondly, though the "waist" is rarely much developed, the "neck" is, in practically all, most marked. Watch a house-fly in the act of cleaning its head with its front legs: the head really seems in danger of coming off. Examine even the cockroach closely, from the side: the large front of the head is seen to be deceptive, for where the head and thorax join, the connecting isthmus is a mere thread. Of these two constrictions the second is fairly intelligible. Sense organs must be easily turned this way and that, especially in a quickly-moving insect, whose surroundings are constantly altering: therefore the head, whither they have already, as in the slowly-moving sidering their tough and brittle nature. What proportion of these hairs and spines are really useless one cannot say. Probably at least they are useful as combs for cleansing the wings and body, as in flies and bees we often see to be the case; but at any rate they are the sign of an unexpected plasticity of nature for such a hard material.

This plasticity we accordingly find made use of in many ways. Perhaps the simplest is that of the great water beetle. In this case the last joints of the hind legs form a slight curve, and the hairs, by increasing in length and becoming parallel, practically fill up the arc so formed, and make a paddle. This beetle, which reaches from an inch to an inch and a half in length, can be found in many streams and ponds. It is carnivorous, living on other water insects. It can be kept in aquaria, but is able to fly well. It would be well to procure one, if possible, and to watch it as it swims: the action of the hind legs is not at all unhuman. Those who are near a stream on which float and curve the curious whirligig beetles will find the motion of these also well worth attention. When on their native pool these beetles are constantly curving and recurving about each other, yet never colliding. If looked at closely, it will be seen that the back legs are largely concerned, and if these are examined from the under surface they are seen to be a far more delicately arranged pair of paddles than those of the previous form. The last four joints of the foot are broadened out into scalelike plates, fringed with hair; and these are arranged in such a way as to spread out and offer the maximum resistance to the water when forced back through it, but to fold one under the other in the least space when drawn forward against it.

We have already mentioned the very powerful leaping leg of the grasshopper.

The bilobed foot of the fly probably acts by exuding moisture and literally sticking its owner to the smooth surfaces on which it walks. Another modification of considerable importance is that of the hind legs of bees. Nearly all bees, when on their foraging expeditions, sustain themselves by eating pollen, and all take pollen home with them. The way in which this pollen is gathered up and passed backward along the under side of the body is curious to watch, and the motions are so co-ordinated as to be difficult to follow. In the main they consist of a scrambling, gathering motion of the two front pairs of legs, together with a forward movement of the body. Being passed backwards, the pollen is stored in various ways. Some bees simply leave it entangled in the hair of the abdomen, others in that of the hind legs; but the most important form of carrier is the broadened tibia. The external surface of this is often smooth and polished, but the internal is hairy, and on it the pollen (moistened by the mouth probably) is stored. On reaching the hive the mass is transferred to the cells; and as the penultimate joint of the foot is flattened, and, in the workers only, the hairs upon it are strong and arranged in comblike rows, it is probable that these members take a prominent part in the process.

In the wings there is, on the whole, less variation, though this is still considerable. The wings are very generally

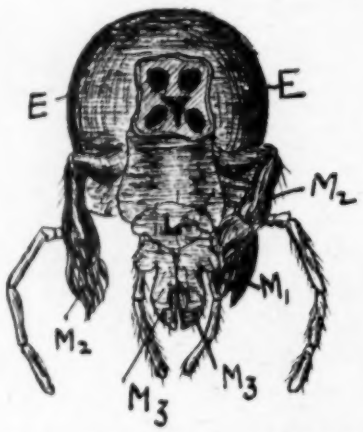


Fig. 2.—Back of Head of Cockroach, removed from body (*from Hurst, somewhat simplified*). The squarish area is the cut neck. The four rounded marks in it represent the four great tracheæ; the T-shaped mark gives position of gullet. M1, The powerful horny mandible of right side. Between the mandibles is the mouth. M2 and M3, The first and second pairs of maxillæ, each jointed and furnished with a palp or feeler. M3, Fuse into one piece, L, at their bases. E, Eye.

four in number, though two are occasionally absent. The dragon-fly, found hawking over streams, the butterfly, crane-fly or "daddy long-legs," grasshopper, and beetle are useful types for the study of wings. Those of the first are the simplest, though most powerful. As in all insects, the wings are divided up by thickenings like veins into areas called cells, and are attached to the hind two segments of the thorax. The butterfly departs from the plan fundamentally only in clothing its wings with beautiful scales, but the rest show more change. In the grasshopper the fore wings are thickened, though still parchment-like, and are relieved of their original function in order to let them assume another. In flight they are held rigid at right angles to the body; at rest they form wing-covers. In the beetles there are no longer visible traces of origin about the elytra or wing-cases. They are used as in the grasshopper, and in the water beetle have other functions also. In the crane-fly and other two-winged flies it is the back wings which are reduced to clubbed stalks, called "balancers," and probably sense organs in reality.

The sole remaining appendages are the mouth parts and antennæ, and the stings and ovipositors or egg-placers. Of these space permits mention of a few only, and that most briefly. The mouth parts of butterflies and caterpillars have already been described. On the whole, the most typical insect to examine is the cockroach—first, while eating; secondly, when dead: in the latter case it should be seen from behind after the head has been cut off. The points to notice are that (1) there are several (three pairs), not one pair; (2) that the pairing is like that of the legs (lateral); (3) that one pair fuse at the base. Given these structures and their power of fusion, the range of change that can be and is obtained is very great. The two great divisions are the cutting and the sucking mouths—the water beetle even has hollow biting jaws for sucking. A useful creature for the study of the mouth is the tiger moth, which can be reared from the "woolly bear" caterpillar. Lettuce is one of its food plants. In the tiger moth the proboscis is very long and large, and the two grooved halves, which by apposition form a tube, are carried free of each other.

Humanly, one of the most important of sucking mouths is that of the mosquito, on account of the communication of malaria of which it is the means. The superb models of the gnat and mosquito, and of the malaria parasite in its various stages in the blood corpuscle, now at South Kensington Natural History Museum, are too fine to be missed by any one interested in natural history.

But one more point of great importance. Kill a cockroach by pouring on it a few drops of chloroform. Now pin it down or half embed it in melted paraffin, back upwards, and allow to cool. Cover with water, and with a pair of fine scissors remove the wings (if any), and cut along each side of the shell, gently lift this, and free from the tissues under it. Notice that the internal organs are covered with a great number of fine silvery lines. These are the tracheæ or air tubes. Remove an air tube for an eighth of an inch or so, and examining with a microscope, notice the parallel markings, produced by a spiral thickening of the tube. Illustrate the way this prevents the tube buckling or kinking, and stopping the air supply, by procuring two rubber tubes, one provided, one unprovided with spiral wire strengthening. Let each lead to a gas-burner: bend each tube at a sudden angle, and notice which light goes out.

Now place a dead cockroach on its back, and very slightly compress it by a piece of board. The top and bottom plates will part a little, showing the pliable membrane between, and in it the air entrances or stigmata.

Finally, cut off the head, and notice the four very large tracheæ which enter the head (corresponding in function to our carotid arteries), and by their great size testify to the importance and need of a good oxygen supply.

No one can, of course, fail to realise that a single article can make no real impression on the mass of facts that could be mentioned. The above work has been chosen as a help to the comprehension of the first lesson of biology—the marvellous plasticity and variability of living matter, and the rigid way in which nature has insisted on the utmost use being made of it.

NATURE KNOWLEDGE.

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LESSONS ON FOOD-STUFFS: 3. DEXTRIN AND GLUCOSE.

LAST month an account was given of the physical and chemical properties of starch, as well as its production from potatoes and maize. Starch is found in all parts of plants: in roots, as in potatoes, the various arrowroot plants, and all edible roots; in stems, as in sago, the pith of a palm; in seeds, as in maize, and all the cereals, as well as in the pod-bearing plants, peas, beans, lentils, which bulk so largely in our food supply. Experiments describing the formation of starch by the green colouring matter of leaves, and its subsequent transmission to the stem for elaboration and storage, have already been explained in the *Practical Teacher*. A very good account of similar experiments, all suitable for ele-

mentary class work, will be found in Wishart's *Botany* in the Self-Educator Series (Hodder and Stoughton, 2s. 6d.).

The important digestive experiment outlined last month shows how easily starch is converted first into dextrin, and finally into maltose or malt sugar; and the present paper deals with similar conversions.

Test with a drop of iodine solution a small piece of bread, and having observed the blue colour which reveals the presence of starch, proceed to toast a slice of bread before the fire. First, steam is expelled from the bread, showing that this food contains water. It is interesting to see roughly how much water any so-called "solid" food contains, and with a fair balance this may easily be done. Weigh accurately half a slice of new bread, then put it in an oven, or wherever it can get a slow steady heat just over the boiling point of water. When all steaming is over, allow the bread to cool, and weigh again. Heat once more, cool, and weigh a third time. If this third weighing agrees with the second, it is safe to assume that all the water has been expelled, and in this case, the difference between the first and last weights gives the loss of water. There is no great danger in overheating bread for this experiment, since it contains no volatile matters which would be expelled by too high a temperature. A comparison of the water-free food in new and stale bread respectively will be a powerful argument in favour of the latter for economy as well as digestibility.

Returning to the toast, it is observed that, when all steaming has ceased, the bread begins to change colour, turning from white to yellow and light brown. If the toasting is done rapidly, the outside of the slice may be charred black while the inside is nearly white; but if the process be slow and uniform, as in making rusks, the whole of the bread will be yellow throughout. Another way of attaining the same result is to boil some salad oil in a basin and dip the slice of bread into the hot oil: since the temperature of boiling oil is much higher than that of water, the result is reached in seconds instead of minutes; and, moreover, the oil, being a liquid, cooks the bread through and through, draining off completely, and leaving the bread of a golden yellow colour throughout. A rusk or well-baked biscuit may be used for comparison. Now take a portion of this, and test it for starch: if the conversion is complete, there should be no starch left. Shake up a small portion with water: it should dissolve completely, and show a sherry tint on adding a drop or two of iodine solution. In short, the starch of the bread has been changed into dextrin, and that by heat alone. The importance of this in all cookery processes involving the heating of starchy foods will readily be perceived. Further, the salivary experiment showed that dextrin is a stage in the digestion of starch: *ergo*, a rusk or biscuit, or other dextrinised form of bread, is to a certain extent pre-digested, and therefore lighter.

In commerce dextrin is made by roasting starch, either over an open fire, or, better, in an oil bath, or by superheated steam, very often in revolving roasters like coffee. For brewing purposes a dark brown colour is no objection, and so the roasting is done at 150° C. or higher; but for other purposes, where a light colour is wanted, the roasting is slowly carried on at a temperature not exceeding 150° C. But generally, when light dextrin is wanted, another process is adopted—namely, conversion by the help of an acid, as follows.

Moisten some powdered starch with one per cent. of strong hydrochloric or nitric acid, and heat slowly in an open dish at 100° C., the temperature of boiling water, till all the acid has evaporated. A safe way of doing this is to put some water in a glass beaker over a lamp to boil, then put the starch into a small porcelain or other evaporating basin, and use this as a lid for the beaker. This is really a simple water-bath, and the temperature in the basin never rises above that of boiling water. A carpenter's glue-pot does as well; but the glass beaker has the advantage of transparency, so that a teacher can prevent it from boiling dry.

Dextrin made in this way is light in colour, and dissolves in water without imparting much colour to the liquid. As "British gum" it is used for the backs of postage stamps, for envelopes, etc., also as a stiffening or dressing for cloth, for putting a gloss on paper or cardboard, and in solution for putting a "head" on beer and aërated waters, though for beer the dark dextrin is more commonly used. The use of dextrin as a substitute for gum is now firmly established. A natural gum may be typified by gum arabic, which consists of the potash and lime salts of arabic acid, $C_{12}H_{20}O_{10}$, a substance resembling starch in composition.

There is still a fourth way of converting starch into dextrin, and that is by the action of extract of malt or diastase, a ferment similar to that contained in saliva. The chemical equation expresses the sum total of the complicated transformations:—

$$\underset{\text{Starch}}{3C_6H_{10}O_5} + \underset{\text{and water}}{H_2O} = \underset{\text{give dextrin}}{2C_6H_{10}O_5} + \underset{\text{and dextrose.}}{C_6H_{12}O_6}$$

It will be seen that the action of malt extract is to add to starch the elements of water, so that the process is often spoken of as the hydrolysis of starch; and that, besides dextrin, there is formed dextrose, or grape sugar. This may be shown by a very striking cookery experiment. Make a small quantity of oatmeal porridge, and make it pretty thick. Dish half of this, and stir into the other half a tablespoonful or so of malt flour. This is a very dry substance, and one which might be expected to make the porridge drier than ever; but instead, the whole mass becomes thin, and even liquid, and on being dished for comparison with the first portion, is distinctly watery and sweeter, with the characteristic odour and honey taste of malt. The thinness of this malted porridge is, of course, accounted for by the conversion of the insoluble starch into dextrin and dextrose, both of which are soluble in water: dextrin gives the honey taste, while the extra sweetness is due to dextrose, or grape sugar. A malted food is therefore to a certain extent pre-digested. Whether malted foods should be used by healthy people is another affair; there is no use of keeping a dog and barking yourself, and nature has an unpleasant way of withdrawing the natural digestive ferments when artificial ones are supplied. They should be used like crutches, by convalescents who have not recovered their full powers, and as a purely temporary support, to be dropped with returning strength. The bearing of this on artificial foods for infants is obvious.

Lastly, the process of converting starch into sugar may be carried out completely. Mix up some starch with cold water, to form a thin cream as for laundry work, then run it slowly into a boiling solution of dilute sulphuric acid; stir and keep boiling for about five minutes. An acid of only one-half per cent. strength gives a more uniform result; but the process is, of course, longer—up to twenty minutes. By this time all the starch has been turned into dextrose, or grape sugar, with a little dextrin, and all that has to be done is to remove the extra sulphuric acid. This is done by adding a cream of chalk and water till blue litmus paper no longer turns red in the liquid; then allow the sediment of lime sulphate to settle, decant off the sugar solution, and filter it through bone charcoal, as is done with common sugar to remove any dark colouring matters; then drive off the water by boiling gently. This gives a glucose syrup: should solid glucose be wanted, the solution must be evaporated in a vacuum pan like ordinary sugar. Commercial glucose, or starch sugar, contains about 70 per cent. of dextrose, from 5 to 10 per cent. of dextrin, and from 10 to 20 per cent. of water, besides small quantities of maltose, inorganic matter, etc.; but these are not objectionable for most of the uses to which glucose is put. Its great use is in brewing, of which more anon; but it is largely used in confections and preserves, and for imitation honey. Since glucose has only two-fifths of the sweetening power of cane sugar, a little saccharine is generally added to bring up the sweetness. Samples of liquid and solid glucose are readily obtainable from any brewery.

EDUCATIONAL SYSTEMS OF GREAT BRITAIN.—A second edition of Mr. Graham Balfour's book on the *Educational Systems of Great Britain and Ireland*, revised and brought up to date, is about to be issued from the Clarendon Press. Mr. Balfour notes that in the four years which have passed since his volume first appeared the amount of unobtrusive progress which has been made by statutes, ordinances, by-laws, and other forms of direction, is far greater than any one would fancy until he has had to examine it as a whole, and then to describe it in detail.

OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

HAITI, WHERE BLACK RULES WHITE.

History.—Of all the islands in the Caribbean Sea, few can compare with Haiti for fertility and abundant natural resources. This island is the Española of Columbus, who landed there in 1492, and the earliest of the Spanish settlements in the New World. The Spaniards named the island after Saint Domenic, to whom they proposed to dedicate the two million Indian inhabitants after they had converted them to Christianity. Such were the methods employed that at the conclusion of the pious labours of the Europeans the aborigines had been worked to death in the mines and plantations. To fill their place, negro slaves were imported as early as 1505. A royal edict in 1517 authorised their importation at the rate of 4,000 per annum; and this continued without intermission, until at the beginning of the nineteenth century the blacks outnumbered the whites by sixteen to one.

The western portion of the island, though nominally belonging to Spain, was occupied by the buccaneers, through whom it was ceded to France at the Treaty of Ryswick in 1697. The eastern portion (San Domingo) remained Spanish. France having in 1722 removed certain restrictions on the trade of its new colony (Saint Domingue), it rapidly attained remarkable prosperity. The French Revolution (1789) led to the insurrection of the plantation slaves, and the colony witnessed terrible scenes, in which black, mulatto, and white endeavoured to outvie each other in acts of studied cruelty. In September 1793, the year in which slavery was abolished, the British invaded the island, but met with little success. The leader of the blacks, Toussaint l'Overture, assisted the French to cause the British to leave the island in 1798.

By 1801 Toussaint had gained complete mastery over the whole island, and having adopted a constitutional form of government, was elected president for life. France, however, sent out 25,000 troops to reduce the colony to subjection and to restore slavery. Toussaint was treacherously seized during an interview with the French general and deported to Europe, where he died in 1803. The blacks were greatly infuriated at this betrayal, and renewed the struggle with the French, who were already sadly reduced by the ravages of yellow fever. To add to the anxieties of the French, a British fleet appeared off the coast in 1803, and eventually 8,000 French surrendered to the British, and formally relinquished their claim to the island.

The next year the independence of the island was declared, and Dessalines, who had succeeded Toussaint in the struggle against the French, became president. The new ruler was assassinated two years later, and then ensued dissensions, the brief enumeration of which would occupy more space than at our disposal. Dessalines's position was contended for by rival chiefs, and the Spaniards reasserted themselves in the east. In 1821 the Spaniards again withdrew, and General Boyer conquered the whole island. Boyer was president of the new republic of Haiti for twenty-one years, when a revolution drove him from the island. In 1843 the eastern portion of the island again reasserted its independence, and since that time the two political divisions have remained distinct.

Government.—Haiti is now governed under a Constitution of October 1889. There is a Chamber of Communes of ninety-five members, elected for three years by direct popular vote, and a Senate of thirty-nine members, chosen for six years by the Chamber of Communes. The president is elected for seven years. Representatives and senators are paid 150 dollars per month during session.

The Haitian government is marked by official peculation and judicial murder, and every possible form of corruption underlies the thinnest veneer of civilised government. Though the last half century has not been marked by any violent upheaval, scarcely a president has been allowed to complete his term of seven years.

People.—The introduction of the African negro to the New World was due to the greed and avarice of European nations, and now the black man presents a problem which the white finds hard of solution. The United States census says the younger generation of negroes is already the most criminal class in the population. Where formerly the black slave was "orderly, fairly industrious, without vices, without disease, and without crime," now the freed man is "dis-

orderly, idle, vicious, diseased, and three times more criminal than the native white." If this diagnosis of the black character under the ægis of a great nation be correct, it needs little imagination to be able to gauge the evil possibilities of black government untrammelled by fear of restraining influences.

Of the negro race in Haiti, J. A. Froude declared: "Haiti has thus for nearly a century been a black independent state. The negro race have had it to themselves, and have not been interfered with. They were equipped when they started on their career of freedom with the Catholic religion, a civilised language, European laws and manners, and the knowledge of various arts and occupations which they had learned while they were slaves. They speak French still; they are nominally Catholics still; and the tags and rags of the gold lace of French civilisation continue to cling about their institutions. But in the heart of them has revived the old idolatry of the Gold Coast, and in the villages of the interior, where they are out of sight and can follow their instincts, they sacrifice children in the serpent's honour after the manner of their forefathers. Perhaps nothing better could be expected from a liberty which was inaugurated by assassination and plunder. Political changes which prove successful do not begin in that way." Such condemnation may appear severe, but European visitors generally assert that progress has not marked the emancipation of the people, who have largely degenerated to the lowest type of African barbarism. Many of the better class Haitians recognise this fact, and would be glad to see France reoccupy the state. They boast of their French connections, and send their children to Paris to be educated.

Dr. Louis Joseph Janvier, the chargé d'affaires of Haiti in London, not very long ago expressed his surprise that "people seemed to think Haiti a troubled sort of place to live in." Under President Hippolite, who served from 1889 to 1896, the republic certainly made remarkable progress. General Simon Sam, who succeeded to the presidency, resigned in 1902. Two candidates contended for the office, with one of whom the navy sided. Fighting ensued, but the chief gunboat of Haiti was destroyed by a German vessel in retaliation for having forcibly taken munitions of war from a German trading vessel. In December last General Nord was declared president, although he had not been one of the contending candidates, and the country again knew less unrest. The rulers of Haiti may claim that peace and stability are now secured, but more civilised nations will see little to guarantee their continuance. The opinion of white people, however, is likely to have little weight in Haiti, for the presence of whites is barely tolerated.

General Features.—The island contains 30,000 square miles, of which 9,000 belong to Haiti. It is decidedly mountainous, with ridges running to the coast in all directions. The climate of the lowlands is hot and moist; that of the highlands averages from 60° to 70° F.; at Port-au-Prince it ranges from 65° to 104°. Earthquakes are unpleasantly frequent, and hurricanes devastate the island at intervals.

There are forests of oak and pine, but mahogany, rosewood, and satinwood are the timbers most in demand. Agriculture is in a very backward condition, notwithstanding the soil and climate render it possible to cultivate cotton, rice, maize, tobacco, cocoa, arrowroot, ginger, coffee, sugar, indigo, etc., etc. Coffee-growing is the principal industry, but it is largely the sole product of the bushes the French left behind; and though Haitian coffee bears an excellent reputation, it would be much better were it not so indifferently cleaned.

The island is rich in minerals. From here the Spaniards wrested the first American gold, and Cortez set out to conquer Mexico. Mining received little encouragement during the French occupation for fear of attracting the outside world; in recent years lack of capital has militated against the industry.

Commerce.—	1898.	1899.	1900.
Exports from Haiti and San Domingo to the United Kingdom	£91,000	£65,000	£56,000
Imports from the United Kingdom	£196,000	£217,000	£327,000

Transit is 15 days; telegrams, 5s. to 7s. per word.

The modern growth of the United States has had a more than indirect bearing on the Haitian trade. Logwood and mahogany account for most of the exports to Britain; cottons, linens, metals, and machinery are the chief articles taken in return.

The roads of Haiti are far better than one would naturally expect, a fact redounding to the credit of the French. The only railway is from Cap Haiti to Grande Rivière, a distance of fifteen miles; but there are several lines in contemplation, the chief of which is to run from Port-au Prince to Salt Lake, and thence to San Domingo. Another project is to connect Cap Haiti, Port de Paix, and Gronaives. In San Domingo there is a line from Santiago to Samana.

Towns.—Port-au-Prince (50,000), the capital of Haiti, is situated at the head of the bay of the same name. Its beautiful situation, palms and oranges growing everywhere in profusion, raises one's expectations to a high pitch. Closer inspection leads to disappointment. "Long before we came to shore there came off whiffs, not of drains as at Havana, but of active dirt fermenting in the sunlight. Calling our handkerchiefs to our help, and looking to our feet carefully, we stepped up upon the quay and walked forward as judiciously as we could. The boulevards were littered with the refuse of the houses and were foul as pig-sties, and the ladies under the parasols were picking their way along them in Parisian boots and silk dresses. Fever breeds so prodigally in that pestilential squalor that 40,000 people were estimated to have died of it in a single year. Above the market was the cathedral, more hideous than even the Mormon temple at Salt Lake. It was full of ladies; the rank, beauty, and fashion of Port-au-Prince were at their morning mass, for they are Catholics, with African beliefs underneath. The whites are treated as they once treated the blacks. They can own no freehold property, and exist only on tolerance. They are called 'white trash.'"

This description of the capital is equally applicable to Jacmel, Cap Haiti, and other towns. The condition of affairs farther inland can better be imagined than described.

No better proof of the utter unfitness of the negro race to rule themselves can be afforded than the condition of Haiti in these early years of the twentieth century.

HISTORY DAY BY DAY.

August.

1st. *Battle of the Nile, 1798.*—Nelson found the French anchored in Aboukir Bay. Instead of ranging in a parallel line, as was then the custom, he sent half his fleet to break the French line, and thus crushed half the enemy's fleet between two fires before the other half could come to its assistance. The destruction of his fleet cut off Napoleon's army from France, and completely upset his scheme for establishing a French empire in the East.

2nd. *Battles of the Pyrenees, 1813.*—No fewer than eight battles were fought between July 25 and August 2, so stubbornly did the French struggle against defeat. In most of the combats the allies were victorious, and Soult was compelled to retire to France, having lost 10,000 men.

3rd. *Columbus set sail, 1492.*—After vainly seeking assistance from Portugal and England, Columbus finally set sail from Palos with three ships, under the auspices of Ferdinand of Aragon.

4th. *Battle of Evesham, 1265.*—The movements of Prince Edward after his escape from his captors proved that he possessed the instincts of a great military leader. Seizing Gloucester and the bridges across the Severn while De Montfort was in Wales, he completely cut him off for a time. Simon, however, effected a crossing in boats, and had almost united his army with the one marching to his relief under his son, when Edward flung himself between the two forces, and completely defeated them. The death of De Montfort on the field of battle robbed England of one of the noblest patriots she has ever possessed.

5th. *Dutch defeated off Dogger Bank, 1781.*—Holland having joined the league of "Armed Neutrality," which advanced the doctrine that free ships make free goods, and no blockade

was admissible unless backed up by a sufficient naval force, war was declared against that country. In the engagement off Dogger Bank the Dutch were put to flight by Admiral Parker.

6th. *Ket's Rebellion, 1549.*—The suppression of the monasteries, and the transference of the abbey lands to the court nobles, led to great agrarian discontent. Twenty thousand men gathered round the "oak of Reformation," near Norwich, to demand the removal of evil counsellors and a prohibition of enclosures.

7th. *Landing of Henry Tudor, 1485.*—Although Richard the Third had endeavoured since his accession to gain the goodwill of the people by every means within his power, when the news of the murder of the young princes leaked out the whole country stood aghast, and when Henry of Richmond landed at Milford Haven he was received with demonstrations of joy.

8th. *Geneva Convention, 1864.*—Henri Dunant, a Swiss journalist, published an account of the horrors he had witnessed on the battlefield of Solferino. A wave of indignation swept over Europe, the outcome of which was an international conference at Geneva to consider what could be done to lessen the horrors of war. Unlike the majority of such conferences, a code was drawn up which was eventually adopted by all civilised nations.

9th. *Education Bill passed, 1870.*—By Mr. Forster's celebrated Act education was made compulsory, and wherever there was a deficiency in school accommodation School Boards were to be elected, with power to draw on the rates for the erection and maintenance of the necessary schools.

10th. *Battle of the Spurs, 1513.*—Not feeling sufficiently powerful to attack France single handed, Henry the Eighth decided to join the Holy League, which had been formed to free Northern Italy from the control of that nation. Henry landed in person in the north of France, and defeated a body of French cavalry at Guinegate; but when he pressed on to regain what he still regarded as his French possessions, he found himself deserted by the king of Spain, who had merely made a tool of him.

11th. *Rowland Hill born, 1795.*—Born at Birmingham, he issued, in 1837, his famous pamphlet on *Post Office Reform*, the suggestions of which were carried into effect three years later. He received a public testimonial, 1846, and was appointed Secretary to the Post Office, which office he held till his retirement, 1864.

12th. *Battle of Verneuil, 1424.*—John, Duke of Bedford, gained a decisive victory over the Scottish allies of France under the Earls of Douglas and Buchan, who were both slain in battle.

13th. *Battle of Blenheim, 1704.*—Louis the Fourteenth conceived the bold plan of uniting with Bavaria and pushing on to Vienna, the possession of which he foresaw would render him master of Europe. Perceiving this, Marlborough hurried his troops with great secrecy through the centre of Germany, and anticipating the arrival of Louis, overran Bavaria. The arrival of Marshal Tallard saved Bavaria from complete submission, and for a short time Marlborough's position was somewhat critical; but when he was joined by Prince Eugene, he was enabled to meet his opponents. The crushing defeat that he inflicted completely destroyed the military prestige that a long series of victories had given to France. Germany was freed from French authority, and Marlborough soon became master of the Lower Moselle.

14th. *Riots in London, 1821.*—The funeral of Caroline, the unhappy wife of George the Fourth, was the occasion of terrible riots as the body passed through London.

15th. *Reform Bill passed, 1867.*—This Act conferred the franchise on all householders, and on lodgers paying not less than £10 per annum. It partially disfranchised several constituencies and created others. It also gave a third member to Manchester, Liverpool, Birmingham, and Leeds, and a representative to the University of London.

16th. *Peterloo Massacre, 1819.*—The tremendous struggle with Napoleon had left the country in an exhausted condition, trade was depressed, and great distress prevailed amongst the working classes. Cobbett, Sir Francis Burdett, and others called for parliamentary reform as a remedy, and a vast meeting of 50,000 people gathered in St. Peter's Fields, Manchester, to support these views. The authorities indiscreetly gave orders for the arrest of "Orator" Hunt, who was addressing the meeting, and in the riot that ensued six people were killed and many injured.

17th. *Battle of Preston, 1648.*—Whilst Parliament and the army were settling what was to be done with their royal prisoner, Charles had been secretly negotiating with the Scots, and the civil war broke out a second time. Before taking the field the heads of the army vowed, on their return, "to call that man of blood, Charles Stuart, to account for the blood he had shed." Twenty thousand Scots poured over the border and advanced to Preston; but Hamilton allowed them to straggle over the country, and Cromwell had no difficulty in cutting them up.

18th. *Battle of Gravelotte, 1870.*—Owing to delay and mismanagement, the French found themselves completely hemmed in at Metz by the German forces. Marshal Bazaine made a desperate attempt to free himself, and for twelve hours the issue was uncertain; but finally the French were outflanked, and were compelled to fall back on Metz again, leaving 19,000 dead on the field. The loss on the part of the Germans was even greater.

19th. *Battle of Carthagena, 1702.*—Admiral Benbow, encountering a superior French fleet in the West Indies, engaged it for five days, until the loss of his leg compelled him to surrender, and he died shortly after.

20th. *Battle of Saragossa, 1710.*—On their accession to power after the fall of Marlborough, the Tories had no desire to carry on the war, and little was done. However, the combined English and Austrian armies under General Stanhope defeated the Spaniards at Saragossa.

21st. *Battle of Vimiera, 1808.*—After Wellesley had been dispatched to Portugal, Sir Hew Dalrymple and Sir Harry Burrard were sent to supersede him. The latter arrived just as Wellesley was attacking Junot at Vimiera; and although he allowed Wellesley to continue in command while the battle lasted, he assumed command when it was over, and, in spite of Wellesley's protests, refused to follow up the victory, thus allowing Junot to withdraw in safety.

22nd. *Battle of Bosworth, 1485.*—Henry Tudor's advance from Milford was one long triumphant procession, and the defeat and death of Richard on Bosworth Field placed the throne within his reach, the weak-minded Earl of Warwick being his only rival.

Battle of the Standard, 1138.—Robert of Gloucester had secured the help of the Scots on behalf of Matilda; but the cruelties of the Highlanders, who overran the northern counties, roused the spirit of the northerners, and they gathered round the sacred banner of Archbishop Thurstan at Northallerton, where the Scottish hordes were completely routed.

23rd. *Buckingham assassinated, 1628.*—Charles had dissolved his second Parliament in order to save his favourite from impeachment. Before the new Parliament met Buckingham fell under the knife of the assassin as he was embarking on his second expedition to assist the Protestants of La Rochelle.

24th. *St. Bartholomew's Day.*

Bartholomew Massacre, 1572.—Catherine de Medicis, fearing that the power of the Condés was growing too great, threw herself on the side of the Guises, and ensured their triumph by a terrible massacre of the Protestants.

The English Bartholomew, 1642.—By the Act of Uniformity 2,000 clergy were ejected from their livings on St. Bartholomew's Day.

25th. *Death of Faraday, 1867.*—Born at Newington Butts, he was apprenticed to a bookbinder, but coming under the notice of Sir Humphry Davy, he was engaged by him as assistant. By his peculiarly lucid style he did a great deal to popularise science.

26th. *Battle of Crecy, 1346.*—Remarkable as this victory of a handful of English bowmen over the flower of French chivalry is from a military point of view, it is yet more remarkable as marking the downfall of feudalism. "For the first time the churl had struck down the noble, the yeoman had proved more than a match in sheer hard fighting for the knight, and from the day of Crecy feudalism tottered slowly but surely to its grave."

27th. *Amoy taken, 1841.*—In consequence of the rejection of the Treaty of Hong-Kong by the Emperor of China, hostilities recommenced, and Amoy was captured.

28th. *Cotton Famine Relief Fund opened, 1862.*—The supply of cotton from America ceased in consequence of the secession of the Southern States, so the mills were closed, and thousands of families reduced to the verge of starvation. A relief fund was started, and during the next two years over £1,000,000 was distributed in the Lancashire cotton district.

29th. *Treaty of Nankin, 1842.*—The fall of Amoy was followed by the capture of Chusan and Ningpo, and soon the troops were before Nankin. Seeing resistance was hopeless, China was glad to make peace on any terms. The concession of Hong-Kong was confirmed; Canton, Amoy, Foochow-foo, Ningpo, and Shanghai were thrown open to British traders; and nearly £6,000,000 indemnity was paid.

30th. *Defeat of Russians at Plevna, 1877.*—After declaring war (April 24), the Russians crossed the Danube and moved toward the Balkans. For a time they met with little opposition, but suddenly the Turks turned on them, and made a desperate resistance. Osman Pasha threw up defensive works at Plevna, and repulsed the Russians with great slaughter.

31st. *Relief of Candahar, 1880.*—Ayab Khan made another attempt to free Afghanistan altogether from British influence. An expedition under Sir Frederick (Lord) Roberts, after a brilliant march, relieved Candahar, and order was soon restored.

PERSONAL OBSERVATION IN RELATION TO COMPOSITION.

AN EXPERIMENT.

"AS the gulls settled down on the field, they looked like a number of school-girls with white pinafores on"—so ran the sentence in the essay I was correcting. There was in my mind a rather vague idea of having seen a similar thought somewhere, yet the directness of the observation in it came with a sense of refreshment in the somewhat routine work of reading the efforts in composition in which the writer is only some twelve or thirteen summers old. For at that age, as we know, the average scholar has but recently climbed the many stiles of mere mechanical difficulties in expression before the greensward of smooth writing is reached; and experience has shown me, as no doubt it has all of us, that these difficulties are left behind more quickly or more slowly in proportion to the personal interest or otherwise of the subject of the essay. This commonplace, however, is sometimes overlooked by us unconsciously, and despite the care given by us to the composition, we are disappointed over the disproportionate return: there is something wanting of directness and grip in it; probably we have for the time fitted the child's horizon of interests into our own. "Pets," for instance, to most children makes a preferable subject to, say, "A rolling stone gathers no moss," or "Ambition;" and a boy or girl would give a more satisfactory bit of work by describing in detail some indoor games played during a wet evening than would be given by telling of the effect of the rains in India, just for the old reason that a man can say more of his own town than of a place he has never seen. And yet, even with such a subject as "Pets," however admirable it is to have the moral of kindness to animals told us in a page of writing, we may get after all a very general essay where the tendency is to repeat formal words and phrases used by dozens of children alike; and I would rather plead for the commonplace of a personal essay, where, for instance, the scholar has his thoughts localised to some pet of his own or of his friend. In this way the mere telling of the peculiarities or habits he has noticed in it will carry him forward the more easily in his essay, and be of much more value than a repetition of general ideas and phrases.

A girl in this way spoke to me of the jealous behaviour of her cat, which, seeing her fondle in a spirit of mischief a piece of fur, at once took an obvious dislike to this new rival. A day or two later the fur disappeared, to be found afterwards in fragments scattered about the garden. The subject is capable of extension, but my idea is to limit the illustration of it to an experiment I made recently, not only to test the observation of the class, but to "bait my line," as it were, for a good result in composition.

For myself the blowing winds and the glad spaces have ever had their special charm. The whaup (curlew) crying in the darkling hills, the summer waterfall drenching the scarlet rowans in a silver spray, the bracken-clad loneliness of the hills, the winter stars above the quiet mere—these and kindred sights and sounds have ever been near the heart; and I was anxious at least to set my class, in the simplest way possible, in the line of this idea. With this purpose I had been speaking to the class of getting out on to a country road, some distance from the noise of the town, and for five minutes standing perfectly silent taking note of every sight and sound during that time, even down to the seeming triviality of a larch tassel or a passing pedestrian; and I had remarked on the amazing number of sounds in such an apparent stillness. After a few days I got the written result, and it was almost in the first essay that the observation re the sea-gulls was made.

In a boy's essay came a simple piece of deduction, all the more valuable because it proved correct. At the beginning of the page he wrote, "I noticed part of a fence broken down (as I thought) for the cattle of a neighbouring farm to pass through;" and after noting other sights and sounds, he ended his paper by remarking, "As I stooped to pick up a primrose the cattle came through the gap," which, by the way, gave somewhat of a neat finish to a school essay.

A similar deduction was tried by another lad, who spoke of a curious sound he heard, as of some creature in pain. Going to the spot whence the cry came, his conclusion was that a bird had been killed by a hawk. The reason for this belief to him was the discovery of some fresh feathers lying there. Of course, it is true that such an inference would not always have held good, and the process of exhaustion might have passed it by, but as an effort in deduction it was not altogether puerile.

"After the cart was past there was a great silence," so ran another sentence, and there came instinctively to the mind many reaches of hill-road where, in the lonely stillness, such an emphasis of quiet was peculiarly impressive.

It was in the essay following a boy described how, after dismounting from his bicycle and leaning it against a telegraph pole, he felt the great silence of the scene. "By-and-by," he said, "there came the dull clanking of heavy carts drawn over rough ground"—a good observation well expressed, as was also that of another writer who said that a trout splashed lazily in the water. This latter sentence was very effectively snapped in short and sharp between other two equally brief, though probably the scholar would be unconscious of using a rhetorical device.

Smaller sounds were also commented on by many, as, for instance, when a girl talked of the slight noise made by the rustling of the bluebells; another spoke of a similar sound through the movements of a hare; while a third remarked on a squirrel breaking a branch high in a tree.

That the girl had actually seen the effect she mentioned was evident in her description of a gently flowing brook, "the small stones moving with the water;" and it was the use of the adjective "usual" that indicated the result of frequent observations in the case of a boy who wrote of the sudden report of a gun followed by "the usual cawing of the crows." Guns suggest rabbits. One lad wrote of watching two rabbits, and a smaller one getting probably its first outdoor lesson. Perhaps it was a similar spirit who talked of an old wall where a number of birds seemed to be discussing something or other. To be quite up to date, a boy brought a motor-car into the essay. "Looking across the field," he continued, "I noticed a rabbit running as though it was suddenly wakened by the sound." That the horses made sounds as though they were tired and sleepy was the contribution of another scholar. A mouse running from a haystack, and the similarity of moving grass to the motion of the sea near the town, were examples of an ordinary bit of observation; but rather differently expressed was the remark

of a boy named Marr to the effect that the telegraph wires made a sound like his own name.

In other cases the sight of a great oak and its stage of growth were commented on; while in one case apart came the following expression, "The trees were very still; not a leaf stirred." "I saw a piece of glass in a field and the sun shining on it till it looked like a precious stone," so a girl wrote in her essay, and with that I was at the end of the correction for the day.

It was the promise in the majority of the papers that made me think of extending the series with "Five Minutes at my Window," "Five Minutes in my Garden," etc., and I will indicate briefly some results from the former subject.

"Looking out," said one of the writers, "I saw a garden-pea on the edge of the wall, and thought that a bird must have been scraping up my father's peas, and dropped one." "As it was pretty late," wrote another, "the first thing I noticed was an owl fluttering past," and the use of the word "fluttering" seemed rather good for the lad's age.

A girl with an eye to colour remarked, "On one side of the road near the house is a large park with dandelions scattered all over it, the yellow looking very pretty against the green."

"Not a sound could I hear in the street; all at once a mil: cart rattled past," so ran another sentence. And was it a touch of humour that made a lad remark on a woman cleaning the steps on the opposite side of the street, "And while she was doing so, talking to her next-door neighbour"? Possibly, however, the lad had no soul for a little gossip, and would much rather be at a hard half-hour's cricket.

A girl spoke of a lady coming out of a shop, of her look of distress as though she had missed something, of her return to the shop, and her reappearance with the umbrella she had left. So the observations came and went. At one time it was a boy passing with his morning rolls, at another it was a homer pigeon flying to his dovecot; while a third referred to a shopkeeper going to the bank with two bags of money, and a fourth was concerned with a labourer coming up to get water to mix with his lime.

I might perhaps close with one or two examples from scholars who live more or less in the country. A description, though slight, of which I thought much, was of some lambs running about in a field: "One would dodge through the hedge, and the others looked on in wonder."

One boy spoke of having watched a number of small rabbits coming out of a wood and sitting down in a circle; while near the end of another such essay was the description of three "basket" caravans coming along the road, the first drawn by two horses, and the horse of the third van almost tired out. A similar ending as of work done was given by another boy, who told of the cattleman taking in some stirks, and the ploughman coming home.

PHYSICAL EDUCATION.

Some Observations and Remarks on Bodily Growth on a Class of Boys in an Elementary School.

BY F. ROSS MACKENZIE, M.A. (EDIN.), F.E.I.S., F.S.T.A.,
FLORA STEVENSON SCHOOL, EDINBURGH.

ONE cannot help noticing that, in the midst of the flow of educational writing and speaking and the public acts of education authorities, the school teacher is regarded as a pawn in the game, who must neither think highly nor be paid highly. Do not despair at this—the public is only a bully, who wants his nose tweaked to bring out respect for the tweaker. And this is by no means a rough or vulgar process. The silent worker is in duty bound to give to his fellows the results of his labours. Bring out your dead, and they shall live.

The research laboratories in all departments of educational work are busy day and night, and no more fascinating subject can be found than physical education. I abhor that word "training." I can "train" wrongly as well as rightly. I can "train" for precocity and not for "harmony." I can "train" for Hooliganism. But I can *educate* only for the *right*, for *harmonious life* and the *keeping of the balance true*. Educate, educate, educate; go slow, observe carefully, record every observation, and philosophise deeply. Your statistics will not overburden your already crowded life.

To take the measurements of a class of twenty-five boys twice a year seems to be adding another straw to the over-burdened camel; but the camel need not find it so. In the time table of this class there is almost one hour a week devoted to practical measurement as enjoined in the Code scheme for Merit Certificate graduands. Why not let the boys measure each other? It will be found that no keener destructive critic is to be found than one schoolboy of another.

Subjoined is a table of measurements so constructed.

The whole proceedings lasted only forty-five minutes on each of two occasions, and during the practical measuring lesson. The teacher kept the records and superintended the tests. A blackboard-upright, marked off at from 54″ to 64″ in half inches, gave a speedy standard. The chest was inflated to full capacity and measured with a tight yard-tape over the shirt. The biceps was in tension, with the fist closed ulnar side up and the arm bent in the elbow. The ages are in years and months. The comparison is as shown in the table below between September 1902 and January 1903, during which period *breathing exercises* and *shoulder-blade movements* were practised in the class with fair regularity once a day.

Gymnastic training under a military expert was given for thirty minutes a week in a gymnasium with a full supply of apparatus.

The following notes are what one would expect from H.M. Inspector, provided that he knew his work:—

1. All seem growing rapidly. Case 7 may require special watching, as an increase of 3¼″ is much beyond normal. No *pressure* towards mental effort should be put upon this lad, and only physical exercising of a mild and guiding character should be allowed until the body settles down to normal growth. His chest is now in perfect harmony with his height. Careful breathing practice will preserve this.

2. The growth in chest measurement over the class is out of ratio to increase of height. This points either to want of sufficient "breathing training" and "shoulder-blade movements," or to excess of exercises involving closing of the arms in front of the chest—for example, rope-hanging, ring-swinging, or *playing with gymnasium apparatus*—a most reprehensible practice, and pregnant with much positive harm.

3. Biceps development is better than chest growth, which confirms "arm-closing" exercises as the cause of fault under (2) above.

4. The number of "stationaries" and "decreases" in calf-measurement (even allowing for hardening "form") point to a lack of toe heaving and raising, lunging, goose-step, and scientific walking practice.

5. In general it is obvious that the extreme cases of abnormal development under and over "harmony" having diminished by 40 per cent., systematic training is asserting itself in the proper way; and as improvement towards "harmony" is shown in every percentage group, save "perfect," it is probable that there is between twelve and fourteen a greater ratio of growth, towards height specially, than is normal or average.

Note.—It is impossible to overestimate the value of the chest in capacity round under the arm-pits, in mobility, and in the rapid and easy movements in the articulations of the ribs with the vertebræ and the sternum.

The teacher remarks on above as explanatory:—

1. That the two cases of highest chest development—2⅜″ and 2½″—were accompanied by increase of height of 1¾″ and 2″ respectively, the former improving as to harmony, the latter showing fault in a good direction—namely, chest capacity.

2. Case 7 deserves special remark, as 3¼″ increase of stature in five months is almost alarming. (1.) This boy had an over-average chest in September last year; but (2) in spite of rapid sprouting he is now only ·003 from harmony. (3.) His mental power, formerly keen, bright, and steady,

has become intermittent, accompanied by halting power of vocal expression and a tendency in composition to increased imaginativeness and mazed, involved sentences. On certain days and hours he seems to have mental lacunas, and cannot be depended upon for continuity of work or thought expression, save in drawing, which is advancing rapidly. He is being treated sympathetically.

Physical Education.

Class (Boys). *Comparison, Sept. 1902, Jan. 1903.*

	Age.	Second Age.	Height (in inches).		Chest (in inches).		Biceps (in inches.)		Calf (in inches).		Sept. '02. Harmony.	Jan. '03. Harmony.
1	13·0	13·5	57	57½	30	29½	9¼	9¼	12	11½	·526	·513
2	13·10	14·3	55	55½	29	29	8	8½	11	10½	·527	·524
3	13·3	13·8	55	55½	28	28	8½	8½	10½	11	·500	·504
4	12·9	13·2	59	59½	30	30½	8½	9	11½	11½	·508	·510
5	12·10	13·3	57	57½	29½	29	8½	9	10½	10½	·521	·506
6	12·3	12·8	51	52	26½	26½	8	8	9½	9½	·519	·509
7	13·4	13·9	55	58½	28½	29	7½	9	11	11	·522	·497
8	12·8	13·1	56	56½	29	28½	7½	9	11½	11½	·517	·504
9	11·10	12·3	57	57½	27½	28½	8½	9½	10½	11	·486	·495
10	13·8	14·1	59	60½	28½	31	8½	9	11½	12	·478	·514
11	12·9	13·2	61	63	30½	33	10	9½	11	11½	·500	·523
12	13·3	13·8	61	62	29½	28½	9	9	12	11½	·487	·464
13	13·3	13·8	56	56½	28	27½	8½	8½	11½	11½	·500	·491
14	13·6	13·11	61	61½	30½	30	8½	9½	12	11	·500	·489
15	13·6	13·11	59½	60	30½	30	9	9	11½	12	·500	·500
16	13·6	13·11	59½	60½	30	31½	9½	9½	12½	12½	·506	·520
17	12·11	13·4	58½	59½	29	29	8½	9½	10½	10½	·495	·497
18	12·11	13·4	57½	58½	30	29½	8½	10½	12	12	·522	·506
19	12·5	12·10	56½	57	31	29½	8½	9½	11	10½	·533	·517
20	13·4	13·9	58½	60	29	31	9	9½	11	11	·495	·516
21	13·6	13·11	54	54½	28½	27½	8	8½	10	10	·527	·506
22	12·1	12·6	60	60½	28½	28½	7½	7½	10½	10	·471	·470
23	12·11	13·4	59	59½	29½	28½	8½	8½	10½	11	·495	·476
24	13·1	13·6	57½	59	29½	27½	8½	9	10½	11½	·519	·500
25	12·3	12·8	56	57½	28	29	8½	8	10½	10	·500	·506

	Increase.				Stationary.	Decrease.				Total Aver. Increase (in inches).
	Per cent.	Max. (in inch.)	Min. (in inch.)	Aver.	Per cent.	Per cent.	Max. (in inch.)	Min. (in inch.)	Aver.	
Height	100	3½	¼	·88	0	0	—	—	—	·88
Chest	36	2½	¼	1·3	16	48	1	¼	·42	·3125
Biceps	64	1½	¼	·66	24	12	¼	¼	·41	·38
Calf	36	¾	¼	·43	36	28	¾	¼	·53	·078

	Sept. '02.	Jan. '03.	
Harmony of Development (Perfect = ·500)	Perfect = 20 %	= 8 %	Beyond normal + or −, Sept. 1902, 36 %; Jan. 1903, 20 %, of whom 2 have over-average chests and 2 under—viz., + ·524 and − ·464.
	± 5 % = 32 %	= 28 %	
	± 10 % = 44 %	= 58 %	
	± 20 % = 64 %	= 80 %	

The teacher must not, however, form the impression that we are making for high specialisation in anatomy and physiology, and are really bringing down an M.D. curriculum on the top of our training college one. Sound common sense and sympathy with child life will bring back all the physiology you need, or will make the acquisition of a further supply a delight. We must, however, be continually alive to physical faults. Just as it would be a distinct reason for the removal of any one of us to another sphere of labour were we to show ourselves unable to be offended with moral faults in our pupils, so too, in my opinion, do we equally impugn our fitness for our high calling by failing to be offended by faulty postures of body in the manifold duties of schoolroom life. There is a correct standing position, and there are many wrong varieties; there is a correct sitting posture, and many wrong varieties. Bring every position to the ultimate test (1) of nature, (2) and subordinately to full healthful functional activity. These I look upon as infallible guides. Conformity with the first will ensure *ease;* for, depend upon it, fatigue is more often the result of gymnastics wrongly applied than of gymnastics properly applied. The second criterion, though elaborative only of the first, explains more, and like a chemical reagent will detect the spurious in any bodily posture, whether of ordinary daily toil, school work generally, or the special forms of posture or movement prescribed by gymnastic courses. And such a test no one who has studied the subject will deny is absolutely necessary.

But our educative influence on the physique of our pupils neither begins, continues, nor ends in the "set lesson." It goes on, maybe, in the silent example of the teacher's personal bearing, hour by hour, minute by minute, in correct standing, sitting, walking, breathing; it goes on slowly, but it goes on surely. Education will always tell in the long run, and we as teachers require no higher argument than this.

PHYSICAL TRAINING.

A PROGRESSIVE COURSE FOR ELEMENTARY SCHOOLS.

BY H. RIPPON-SEYMOUR, A.C.,

Chief Instructor, George Watson's College, Edinburgh; Member International Congress of Physical Education, Paris, 1900; Author of "Physical Training," etc.

NOTE.—The military commands given throughout this course are almost exactly in accordance with the commands in the *Infantry Training, 1902*, and the *Model Course*, except where experience has shown a modification desirable. The alternative command will generally be shown in a footnote, and the teacher is at liberty to adopt either.

NINTH LESSON.

Barbell (or Staff) and Physical Exercises.

(The words of command are in heavy type.)

BARBELL EXERCISES.

These exercises are suitable for pupils twelve years of age and upwards. They will be found useful in the training of boys who may one day join a cadet or volunteer corps, as many of the movements are similar to those used in military rifle exercises.

Frequent practice with this apparatus will tend to eradicate "stooping" and round shoulders, if attention is paid to the correct positions from the commencement. The barbells should be of at least two lengths—namely, 44 and 50 inches, to suit the varied height of the pupils.

94. **"Attention"** (with barbells).—The pupils will assume the position of "Attention" before described (2), holding the rod of the barbell lightly between the first two fingers and thumb of the right hand, the lower end of the bell on the floor close to the right foot, the upper end close to the shoulder (Fig. 1).

95. **"Stand—Easy."**—Push the *top* of the barbell forward about six inches, and at the same time carry off the left foot as before described (8). The right hand may be allowed to slide upward along the rod a few inches, the left hand being placed in the hollow of the back, as in "Stand Easy."

96. **"Ready."**—Give the bell a short upward throw of about six inches, and at the same time carry the left hand across and grasp the bell just below the height of the shoulder, back of the hand to the breast.

"Two."—Bring the bell smartly down to a horizontal position in front of the body, both arms straight. The bar should now be divided into about three equal parts, that part between the hands being equal to the parts outside the hands (Fig. 2).

97. **"Hands—Apart."**—Relaxing the grasp of the hands somewhat, slide them both smartly outwards as far as the knobs, or until sufficient distance is obtained to allow the pupil to pass the bell over his head, with arms *straight.*

N.B.—This movement is only necessary with certain exercises.

Barbell Exercise, No. 1.

98. **"Ready."**—As described in 96, "Two."

"One."—Raise the bell quickly above the head, in a horizontal line, head well up, eyes directed towards the bell.

"Two."—Bring the bell well down behind the shoulders, the elbows pressed back, the chest forward, head erect, eyes to the front.

"**Three.**"—Resume the position described in "One," pushing the bell smartly upward.

Fig. 1.

"**Four.**"—With the arms and legs quite straight, bend forward from the hips and lower the bell to the insteps (or as low as possible without bending the knees), reaching well out to the front in so doing.

Continue until the class has attained fair proficiency and accuracy of movement, but not more than six times through without "standing easy." In "judging the time," eight times through the exercise should be sufficient. The last movement is made by bringing the bell down to the "Ready" instead of to the insteps.

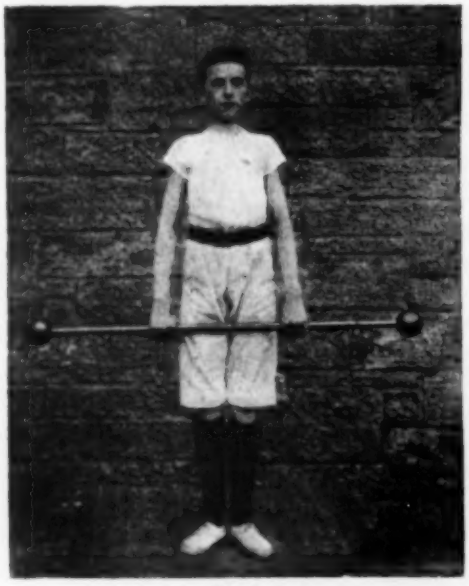


Fig. 2.

Barbell Exercise, No. 2.

"**Hands—Apart.**"—As before described (97).

99. "**One.**"—Raise the right hand over toward the left side of the head, the right fore arm just in front of and a little higher than the head, the barbell vertical and the body erect.

Fig. 3.

The left hand should scarcely move from its position at the left side, merely moving sufficiently to allow the bell to rise.

"**Two.**"—Carry the bell over the head and behind the back to the full extent of both arms, the left hand leaving the left side enough to allow of the body occupying a central position between the somewhat extended arms (Fig. 3).

"**Three.**"—Raise the left hand to the position described for "One," the right hand moving close to the right side, the barbell in a vertical position close to the front of the right arm and shoulder.

Fig. 4.

"**Four.**"—Bring the barbell down smartly to the position of "Hands Apart" in front of the body.

When these four movements are thoroughly learned, they

may be reversed, the left hand moving first, the commands being "**Five,**" "**Six,**" "**Seven,**" and "**Eight.**"

Barbell Exercise, No. 3.

"**Hands—Apart.**"

100. "**First part—One.**"—Raise the barbell smartly over the head, arms straight, head well back.

"**Two.**"—Keeping the arms straight, carry the bar down to the full extent of the arms behind the back, head erect.

"**Three.**"—Raise the bar over the head, as in the "first position," keeping the arms straight while so doing.

"**Four.**"—Resume the position of "Ready, Hands Apart." Continue this exercise four or eight times through by "numbers."

"**Second part—One.**"—Swing the barbell over the head and behind the back in one movement, with straight arms.

"**Two.**"—Lift the barbell over the head, and reaching well forward, resume the position of "Hands Apart."

Repeat eight times, or sixteen movements in all.

PHYSICAL EXERCISE.

In the following exercise the pupils require some assistance. This is obtained by one pupil, or rank, helping another. As a general rule, these more advanced movements are unsuitable for girls.

The class will be first extended from the right, or left (69), and, if required, the front rank turned facing the rear rank.

101. "**Bending the knee, with assistance—Ready.**"—On this command the pupils of both ranks (who should be facing one another) grasp their partners' hands, right to right, left to left, the front rank at the same moment raising their left foot to the front 12 inches from the floor, toe pointed.

"**Bend.**"—Keeping the left heel above the floor, the front rank will bend the right knee until the calf of the leg meets the thigh. The rear rank pupil retains a firm grasp of the hands, and assists his partner in maintaining his balance (Fig. 4).

"**Stretch.**"—The front rank pupils will slowly rise to the position of "Ready," keeping the left foot *off* the floor.

Only perform this movement once, or at most twice, at a time before changing ranks or feet.

"**Change.**"—The front rank pupil drops his left foot, and the rear rank pupil raises his left.

"**Bend.**"—As described for the front rank above.

"**Stretch.**"—As described for the front rank above.

"**Change.**"—The rear rank pupil brings the left foot down, the front rank pupil raises his right foot. The exercise continues in this manner until each pupil has performed the movement in alternate ranks with each leg.

"**Attention.**"—Release hands and come to "Attention."

The author will be pleased to answer in these columns questions of general interest on drill and physical training. Letters should be addressed to the **Author, care of the Editor,** *and must enclose the coupon on back page of cover.*

HOW TO DRY AND MOUNT FLOWERS.

BY A. FLEETWOOD MORROW.

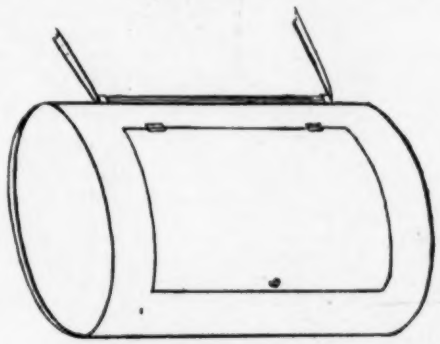
THE warm days are with us again, and we have an abundance of flowers with which to illustrate our lessons; but we must often have felt during the winter months what a help it would have been if we had had a few good mounted specimens to take the place of the flowers which were then so difficult to obtain. A dried and mounted specimen can, of course, never be so full of practical instruction and use as the growing plant; but if properly prepared, it is a wonderfully good substitute. The mounted specimen should, if possible, show the whole of the fully-grown plant, special care being taken to emphasise any peculiar characteristics, such as that from which the name of the plant may have been taken, etc. In some cases it will be found that a very young plant pressed, in addition to one of mature growth, will throw an interesting light on the ancestry and family history of the plant. The gorse furnishes a good example, its young leaves being totally different from those with which we are more familiar, and telling us much about the history of the plant. The root, of course, must be shown, and, where possible, the seed also should have a place on the sheet. It will at once be seen that many plants—such, for instance, as the wild rose—could not possibly be dried and mounted complete on a sheet of paper of convenient size. In such cases sections should be shown, giving the leaves, flowers, etc., and any peculiarity characteristic of the plant.

It cannot be too clearly understood that a mounted specimen to be of any practical value must be thoroughly and carefully dried. The writer has seen many sheets of dried specimens which certainly conveyed no idea whatever of the forms of the growing plants, and could have been of no use in illustrating a lesson. The mounted specimen should be not only a correctly prepared scientific object, but should be a thing of beauty and a joy to its possessor.

The outfit required is neither large nor expensive.

1. A tin to hold the newly gathered specimens.
2. A very strong, small garden fork or trowel.
3. A flower press and straps.
4. A good supply of thick white blotting-paper.
5. Fairly stout drawing-paper.
6. A few small items, such as best gum arabic, strips of gummed paper, etc.

The collecting tin should be of fair size, say about 12″ × 8″ × 4″, but this must be left to individual taste and requirements. It should be large enough to hold specimens of fair size without crushing them, and should be so arranged that it can be carried over the shoulder by means of a strap. It should not be large enough to be unduly burdensome. Opinions vary as to the best shape, but perhaps that shown by the illustration will prove to be the most convenient.



BOTANICAL TIN.

Some plants, such as twayblade, will be found to be too large to place in the tin without damaging them. They should be cut into two or more sections, great care being taken to keep such sections together. This dividing of specimens should be resorted to in all cases where the plant will not bend without breaking or being much crushed. As far as possible, keep all the roots together, so that the leaves and blossoms may not be soiled. Sometimes a little soft paper wrapped round a root will save much damage to the other specimens in the tin, and will well repay the small amount of extra trouble taken. The writer has found it convenient to carry a small tin in his pocket for delicate blossoms and very small plants. He also carries a small press, consisting of two very stout pieces of cardboard about 3½″ × 4½″, and a few pieces of thick white blotting-paper of the same size, the pressure being obtained by means of two small deed straps. This will be found almost invaluable, as it will enable you to press at once such blossoms as would be faded and ruined before you could reach home. It should, however, be used sparingly, except where necessary, as it takes up time, and curtails the pleasures of the walk.

Flowers should, as far as possible, be gathered dry. If gathered with the rain upon them, they are much more difficult to preserve satisfactorily, as they must remain longer in the press, and are more likely to change colour. If, however, you should secure specimens on a rainy day, dry them as thoroughly as possible before placing them in the press. It is very important to get the roots of specimens perfect, and for this reason it is essential that the fork or trowel used should be as strong as possible, but not large enough to be cumbersome. It will often be found that the soil in which some of our wild plants grow will try the strength of the fork to the utmost; and there are few things more trying to the botanist than to find a valuable specimen, and to spoil it for want of a proper tool, or through a tool breaking. Some may prefer a trowel to a fork, but it breaks more easily—at least that has been the writer's experience. Do not attempt to clear the roots of all soil until you can wash them under a tap at home. If you try to do too much in the field, you will probably break the roots and spoil the specimen. Many plants, such as the wild hyacinth, have thick succulent stems, which would take a very long time to dry if treated in the ordinary way. With such plants it is advisable to cut away the back half of the stem; if done carefully, this will not be noticeable when the specimen is mounted, and will very materially hasten the process of drying. The writer has also found it desirable in these cases to detach the florets and dry them separately. This, however, should not be done unless you are willing to spend considerable time and take special care, as it is obvious that very absurd mistakes might easily be made—such, for instance, as failing to replace each floret in its right position, and in that way getting a half-opened floret where one fully opened should appear. If, however, you are willing to take the extra trouble—which by-the-way will be more than justified by the improvement in the specimen—cut each floret away quite close to the stem, being careful not to injure any bracts, etc., which may be there; and as you cut them away, arrange them in order on the paper in your press, as shown in the illustration, and be careful when changing the paper during the process of drying to keep them as nearly as possible in the relative positions which they will occupy when mounted. The rest of the plant should be dried on another sheet of blotting-paper. There should be no great difficulty when mounting your specimen in replacing the florets, so that they appear to grow naturally from the stem. It is not usually advisable to dry the root separately, as its removal would often cause the rest of the specimen to fall to pieces; but it should, if thick or succulent, be treated in the same way as the stem. In such cases as the early purple orchis, it may be found advisable not only to cut away the back half of the tuberous roots, but also to scoop out a certain amount of the fleshy substance of the remaining half.

It is not necessary to have a large press; $10\frac{1}{2}'' \times 13\frac{1}{2}''$ is a very convenient size, as it takes a large sheet of blotting-paper (as usually retailed at 1d.) divided into four. The press consists of two stout boards of oak, or other hard wood, strengthened by cross-pieces, which should be fixed by screws. The necessary pressure is obtained by means of strong straps.

We will now suppose that you have all your materials ready, and specimens waiting to be pressed.

Take one of the boards of your press, and on its smooth surface lay at least three sheets of blotting-paper; then take your specimen, and place it so that all its parts lie well within the edges of the paper. It may be necessary now to apply a little pressure with the finger to some of the leaves, etc., to flatten them somewhat before placing a piece of blotting-paper over the specimen. It may even be necessary to cut away a few leaves to prevent overlapping; but this must be done sparingly and with care, and a portion of the stalks should be left to indicate where the removed leaves had grown. The next step is perhaps the most difficult of all, as the beauty and perfection of your dried specimen will largely depend upon how you manage to arrange the plant in the press. Having arranged the specimen as described, place the covering-sheet of blotting-paper so that one of its edges coincides with the corresponding edge of the under sheet, and lower it by degrees, arranging the specimen as you do so, and removing, as far as possible, all creases from the leaves, etc. Above all, be careful to arrange everything so that the natural manner of growth of the plant will be shown by the specimen. Any mistakes which cannot now be rectified may be put right on the second day when placing the specimen between fresh dry paper, as the plant will then be quite limp and easy to rearrange. Having the specimen now between two sheets of blotting-paper, place one or two additional sheets on top, so that there may be an even pressure over the whole of the specimen, and also plenty of paper to absorb the moisture from the plant. The use of several sheets between two specimens is especially needful when one of the plants has thick flowers or stem. Now proceed with your second specimen in precisely the same manner, and so on until you have all your plants arranged between blotting-paper; then place the other board on top, and draw your straps tight, so that you secure a good firm pressure. It is

DIAGRAM TO ILLUSTRATE THE METHOD TO BE ADOPTED IN DRYING THE FLORETS OF A PLANT WITH SUCCULENT STEM, ETC.

only necessary to have sufficient pressure to keep the specimens perfectly flat without any possibility of shrivelling. Too great a pressure would bruise and completely spoil some specimens. Now put the press in a warm, dry place until next day. It will be found advisable to have a good stock of blotting-paper, so that you may always have a sufficient quantity to substitute for the damp paper in the press day by day. The method of changing the paper is as follows: Take the top board of the press, place it on the table, and on it lay two or three sheets of dry paper; then remove and lay aside the damp sheets until you come to a specimen, being very careful lest a portion of the specimen should adhere to the paper and tear away; then place a sheet of dry paper over the specimen and raise the specimen between this dry sheet and the damp sheet beneath; carefully turn it right over, so that the dry paper is now underneath, and place it on the dry sheets already in position on the board. Great care should be taken, especially for the first two or three

days, to keep the specimen from moving about between the two sheets of paper during this operation. Next raise one end of the damp sheet of paper and gradually bend it back until it is all raised, and the specimen left on the dry sheet. Should any portion of the plant stick to the paper, it must be very carefully removed. This may often be done by pressing fairly hard with the finger just over the part that sticks, as you bend the sheet back. Next smooth out any leaves, etc., that may have been accidentally doubled over on the previous day, and correct any other mistakes which you may notice. Repeat these operations until you have all the specimens between dry paper, and do so every day until your specimens are perfectly dry.

The specimens when thoroughly dry should be mounted on fairly stout drawing-paper. If thin paper be used it will too easily bend, and the specimen will either break or become detached from the paper. For general purposes the size most convenient may be found to be that obtained by dividing an imperial sheet of drawing-paper into four parts; this will be large enough for most specimens. White paper

BEE ORCHIS.

is generally used, but the writer has found that many specimens, especially those with white flowers, look better on a tinted paper. This, however, must be left to individual taste. Now lay the specimen wrong side up in the middle of a sheet of blotting-paper rather larger than the sheet on which you are mounting the specimen, and carefully go over it with a strong solution of gum arabic; then place your drawing-paper on the specimen, being careful that its edges are parallel with those of the sheet on which the specimen was placed. When the drawing-paper is raised the specimen will be found in position, and a little pressure will cause it to adhere more firmly to the paper. It may be found necessary to gum one or two portions afresh, but care must be taken that the gum does not spread beyond the outline of the plant and so disfigure the sheet. If you place the plant carefully in the centre of the piece of blotting-paper before gumming it, and show the same care in superposing the drawing-paper, the specimen will, of course, be found properly placed in the centre of its mount. A little thought and ingenuity will often enable you to add materially to the pictorial and educational value of a mounted specimen. For instance: The bee orchis takes its name from the very remarkable resemblance of its flowers to bumble-bees. The writer accordingly detached several florets and dried them separately, in addition to a perfect specimen of the plant, and mounted them around that specimen; and the resemblance to flying bees is certainly very striking, besides which the origin of the plant's name is thereby emphasised. In the case of the great family of Cruciferæ, or cross-shaped flowers, he has detached the petals of one floret, dried them separately, and mounted them, in the shape of a cross, by the side of the plant. Other instances will doubtless suggest themselves, but it is perhaps advisable not to give the fancy too free play. Should any portion of the stem of a plant show a tendency to break away from the paper, a thin strip of gummed paper should be placed across it. The same means will also serve to hide any joins which have been made in the case of specimens dried in sections.

There remains now only the labelling or naming of the specimen. The writer has an india-rubber stamp with which he marks the lower left-hand corner of each sheet as follows:—

Order.....
Latin name.....
English name.....
Locality.....
Date.....
Collector.....

Others may perhaps prefer to use a printed and gummed label bearing the same details.

There are many books which the collector will find useful, but for general use Johns's *Flowers of the Field* will be found very lucid and helpful. Those who wish to go more carefully and deeply into the subject will find Hooker's *Student's Flora* a very exhaustive work, and abounding in minute and helpful detail. The writer would again emphasise the need for careful work; and trusts that what he has written may enable many teachers to form a collection of flowers which will be not only a joy to themselves, but a means of pleasant instruction to those whom they teach.

THE TEACHING OF PRACTICAL GEOMETRY.

BY W. H. FOSTER, B.A., ST. JOHN'S COLLEGE, CAMBRIDGE.

Section D.—The Scalene Triangle.

PROBLEM IV.—*Construct a triangle having its sides respectively equal to three given lines.*

Take lines, say, 2 in., 1·5 in., 1·6 in. long, and using one as base, construct a triangle upon it having its remaining sides equal to the other two lines.

EXERCISE 1.—*Construct all the triangles that are possible with these three lines as sides.*

To do this, take each side as base in turn.

It will appear to the beginner that three different triangles should result, and he will be not a little surprised to find that on cutting them out and placing one on the other they are not only the same size but also the same shape; hence we impress on his mind the fact that *triangles with their sides respectively equal are equal in every respect.*

To show that it is not sufficient for the sides to have the same *total length* merely, other lines having the same total length are taken and the exercise repeated, and the figure compared with that of Exercise 1.

EXERCISE 1a.—*Try to construct a triangle having sides 1 in., 2 in., 0·75 in. long.*

Why is it not possible? (*Any* two sides must be *together* greater than the third.)

EXERCISE 2.—*Make a triangle ABC of any shape. Make another on AB, but on the opposite side.*

There are two ways of placing the second triangle. Both the resulting figures should be drawn and compared. One is the *rhomboid*, the other the figure which we have had already several times. (Section C, Exercise 3a.)

Notice that this construction would simplify Exercises 1 and 1b, Section B.

EXERCISE 2a.—*Repeat Exercise 2, making another triangle DEF apart from ABC—that is, copy the triangle ABC.*

It is possible, of course, now to copy any rectilinear figure. It is only necessary to divide it into triangles and copy them successively.

Several figures should be given as examples to be copied.

These might be "graphed" and given out, the children either copying them direct from these papers, or first transferring them by pricking them through on to their drawing paper, a useful device which they may often turn to account later in solid geometry exercises.

In copying the triangle we have practically copied an angle—in fact three angles. To copy an angle it is only necessary to convert it into a triangle and copy the triangle. The practical method, which may be shown side by side with this, really consists, of course, in first constructing an *isosceles triangle*, and then copying it.

Notice also that we have here a means of comparing angles *without cutting them out*. Many exercises in foregoing sections might now be repeated, the class verifying for themselves the truths established then only by the teacher.

An endeavour has been made to render the sequence of the exercises and problems in this course logical, hence the reason for avoiding this method of comparing angles at an earlier stage, and resorting to the "method of superposition."

An opportunity is also afforded here of pointing out that in comparing angles by this method we really compare two arcs in equal circles—another instance of an arc serving as a measure of an angle.

As we have now had several examples of all the different kinds of parallelograms—namely, the square, rhombus, rectangle, rhomboid—these figures should here be referred to collectively, and the parallelism of their opposite sides demonstrated by producing them. This could be very forcibly impressed upon the pupil by allowing him to construct these figures on squared paper. He then sees at once that the opposite sides are parallel. A fuller consideration of parallel lines is, however, reserved for a later section of the scheme.

It will be seen that we have now investigated pretty thoroughly each of the three types of triangle that were brought before the pupil's notice in the preliminary exercise. He might now, therefore, be set to work to collect all the facts that have been learned about each, and to compare them. Another useful exercise, and one that serves to sustain the interest of the learner in the subject, is to set him to devise problems for himself. It will generally be sufficient to suggest that one exercise shall introduce a square, another an equilateral triangle, or both, and so on. The class should also now be in a position to construct simple designs for themselves, taking as the basis one or other of the regular figures they have learned to construct.

Section E.—Bisection of a Straight Line and Arc of a Circle.

PROBLEM V.—*Bisect any given straight line.*

Refer to Section C, Exercises 3 and 3a. What we want is now the quickest and most practical way of getting the middle point of a line. This can be left to the pupil to find out for himself. It resolves itself into this: Given the line AB, obtain Fig. 1 (the left-hand figure only), and so get the point E.

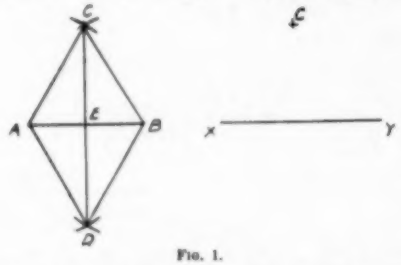


FIG. 1.

We know also that the line CD is at right angles to AB, so we have also the problem:—

EXERCISE 1.—*Draw a straight line at right angles to another through its middle point.*

It is important to lay stress from time to time on the fact that geometry enables us to solve our problems by methods which are sure to succeed, always provided the working is accurate, and is thus opposed to guessing or "rule of thumb," which inexperienced people have to fall back upon in solving similar problems. This is one place in the course where this might, I think, be done with good effect.

It is worth while to call attention to the distinction between Problem V. and Exercise 1. If we do not want the line at right angles, it should not be drawn in practice, as it only tends to complicate the figure; and there are many cases where it is not required at all.

We proceed at once to use the fundamental problem to enable us to work another series of interesting exercises, and to further investigate the properties of triangles and quadrilaterals. Notice, again, that we employ our fundamental problem in each case, and thus get frequent exercise and practice in the use of it.

EXERCISE 2.—*Draw any scalene triangle ABC with sides, say, 3 in., 2 in., 2½ in. long respectively. Find the middle point F of one side AB. Join F to C.* (Fig. 2.)

It is clear that the triangles AFC, BFC are not the same shape. Are they the same size? You will find they are if you try it with squared paper. That it is not an accidental result is shown by the fact that all get the same result though their triangles may be all different.

The line CF is called a *median*. (It is the *median* line of the triangle.)

EXERCISE 2a.—*Repeat with an isosceles triangle ABC, the equal sides being AC, BC; D the middle point of the base AB.*

Notice the effect of symmetry in this case. The isosceles triangle is symmetrical about *this* median.

The equilateral triangle will, of course, give a similar result.

EXERCISE 2b.—*Find the middle points of all the sides of the scalene triangle in Exercise 2, and draw all three medians.*

This is an excellent problem for testing the accuracy of the pupil's work, and he should at this stage have become fairly proficient. The three *medians*, of course, all pass through the same point.

This figure will repay careful investigation. Notice how many

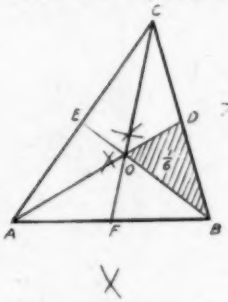


FIG. 2.

triangles are *equal in area*, and half the original triangle. There are *six* of them.

The three triangles OAB, OBC, OCA are also equal in area, as can be shown by having recourse to squared paper again.

Notice that the point of intersection O cuts off one-third of each median. (Hence divide each median into three equal parts.) If a triangular lamina (of tinplate or cardboard) be suspended by a string attached to an angular point, the prolongation of the string is along a median.

The point of intersection of two medians (or three) is the *centre of gravity* of the triangle; and if the string is fastened to any other point, the prolongation of the string will always pass through this point. The triangular laminæ could be "balanced" about this point. (They are supposed to be of material of uniform density.) It should be shown that this point is not equidistant from the angular points of the triangle (nor from the sides.) It is, therefore, not the centre of the described or inscribed circle, but the *centre of the triangular space*.

EXERCISE 2c.—*Instead of drawing the medians as in Exercise 2b, repeat the exercise, but join the middle point of the sides one to the other.*

We thus get four similar and equal triangles, and each triangle is—

(*a*) The same shape as the large one.

(*b*) One quarter the size of the large one.

Cut them out, and fit them one on the other.

Compare with Exercise 2*a*, Section A.

Each side of the inner triangle is parallel to a side of the large one.

EXERCISE 2*d*.—*Repeat Exercise 2b, with an equilateral triangle (side 3 in.).*

Notice how the result is affected by the regularity (symmetry) of the equilateral triangle.

In this case the point of intersection of the medians is the centre of the inscribed and circumscribed circles.

Repeat also Exercise 2c with an equilateral triangle. (Compare also with Exercise 2a, Section A.)

EXERCISE 2e.—*Draw any irregular four-sided figure. Find the middle points of the sides. Join each to the next. Show that the*

inner figure is always a parallelogram, and is half the outer in area. (Do it on squared paper.)

EXERCISE 2*f*.—*Repeat 2e with a square, and notice again the effect of the regularity of the figure. Join also the middle points of opposite sides, and thus divide the square into four equal squares.*

Try the exercise also with the rectangle, rhombus, and rhomboid.

EXERCISE 3.—*Describe a circle, radius 1½ in. Draw a chord AB (about 2 in. long). Bisect this chord, drawing the bisecting line to cut the arc AB.*

Notice that the arc is bisected as well; hence—

EXERCISE 3*a*.—*Bisect any given arc of a circle.*

Notice also that the bisecting line passes through the centre—that is, it is a diameter; hence—

EXERCISE 4.—*Find the centre of a circle* (by first drawing a chord).

Note.—The circle for this exercise should not have its centre shown. (Circular metal discs are useful for describing circles in such cases.)

Hitherto we have supposed the centre of the circle known. There is nothing very objectionable in this, since the circles have always been described by the pupils; but it should now be pointed out that cases might occur where the centre must be found, and the exercise just given will enable them to find it with certainty in such cases.

EXERCISE 4*a*.—*Describe a circle, radius 3 cm. Draw a diameter. Bisect this by a line at right angles, and thus obtain four quadrants. Join the extremities, and thus place the largest possible square in a circle.*

EXERCISE 4*b*.—*Bisect each quadrant, and then inscribe the octagon.*

The octagon is worth a little attention. Its relation to the square should be shown, and its angles determined if possible. An attempt might then be made to construct an octagon on a given line, as side.

EXERCISE 4*c*.—*Find eight equidistant points on the circumference of a circle. Join each to the next but one. Obtain the eight-pointed star.* (Compare with Fig. 9, Section A.)

EXERCISE 4*d*.—*Draw two lines 3 in. long, crossing at right angles and bisecting each other. Join their extremities, and obtain a square;* hence—

EXERCISE 4*e*.—*Construct a square having the diagonal given.*

EXERCISE 5.—*Draw a scalene triangle again, as in Exercise 2. Bisect each side, and draw the bisectors. Notice that they intersect at the same point.*

This point is not necessarily *in the triangle*. It is, of course, the centre of the described circle.

EXERCISE 5*a*.—*Describe a circle about a triangle, using the fewest lines possible.*

EXERCISE 5*b*.—*Find a point equidistant from three given points.*

How many points fulfil this condition? Compare with Exercise 4, Section C. Notice the effect of introducing a third point.

Place the three points all in one straight line, and then try to find a point equidistant from all three.

Is it possible to have a point equidistant from *four points?*

EXERCISE 5*c*.—*Find the centre of a circle.* (Second method.)

Take three points on the circumference and join them to form a triangle.

EXERCISE 5*d*.—*Find whether two lines inclined at an angle, and of equal length, are the sides of a regular polygon which can be inscribed in a circle.*

EXERCISE 6.—*Complete the circle of which a given arc is a part.*

EXERCISE 6*a*.—*Find the angle corresponding to a given arc.*

EXERCISE 6*b*.—*Find which of two given arcs corresponds to the greater angle.*

Section F.—Construction of a right angle. (Third method.)

PROBLEM VI.—*To draw a line at right angles to another from a point outside it.*

The pupil may be left to devise a method, using the figure of Problem V. as a guide. It resolves itself into this. Given point C and the line XY (Fig. 1), to construct the figure on the left, and so obtain CD, AB to form part of XY. It is a good plan to let the pupils try the problems in this way for themselves first, though all may not succeed in solving them.

EXERCISE 1.—*Repeat now by a practical method.*

Show that this line is the *shortest* that can be drawn from C to XY, and that as we go away from it the lines get longer. Also, that we can have *pairs* of equal lines, one line of each pair being on either side, *but not two equal on the same side.*

The lines drawn to a concave or convex surface may also be examined in a similar way.

Since CE is at right angles to XY, C is the centre of a circle which will touch XY at E; hence—

EXERCISE 2.—*Describe a circle to touch a given line with a given point as centre.* (Compare Exercise 2, Section B.)

Only one such circle is possible. This is the method that must always be used to perform this operation. We must never get the length of the radius *by trial.*

EXERCISE 2*a*.—*Inscribe a circle in a square and in a rhombus. Try also in a rectangle.*

EXERCISE 3.—*Find the shortest distance from the angular point A of a triangle to the opposite side.*

This is called the altitude if the side is chosen as base. Notice that this line does not always meet the side unless produced.

EXERCISE 3*a*.—*Draw a perpendicular* (*as in Exercise 3*) *from each angular point.*

Notice that they all pass through a common point again. Is this point the centre of any particular circle, inscribed or described, for example? (Compare with Exercise 5, Section E.)

Projectors and Projection.

EXERCISE 4.—*Draw any line AB about an inch long, and another XY, some distance from it, of indefinite length.*

Draw perpendiculars from A and B to X and Y. CD (Fig. 3)

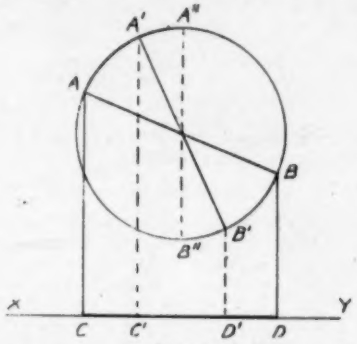


FIG. 3.

is the projection of AB on XY. The lines AC, CD are termed projectors.

Notice the effect on the projection of AB as this line revolves round its middle point as a pivot. (Bisect it, and describe a circle with the line as diameter. Draw other diameters.) This is an important exercise in view of the solid geometry which might be introduced shortly in the course. No harm would be done now by allowing the pupil to project lines by means of set squares; and this instrument might now be introduced and explained, and its use allowed in some examples, even in plane geometry, where it might result in much saving of time.

Section G.—Bisection of an Angle.

PROBLEM VII.—*To bisect a given angle.*

This operation has been performed already several times. We introduce it as we did Problem VI., showing the class what is represented in Fig. 4. They are told to convert the angle P into

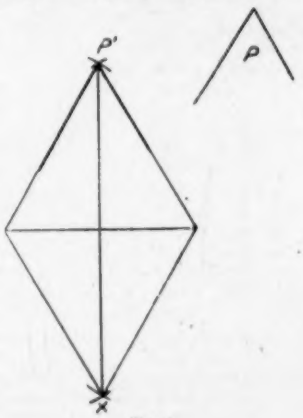


FIG. 4.

the figure on the left of it, and so obtain P'X, the bisecting line. This is then to be followed up by the practical method.

EXERCISE 1.—*Bisect an angle in the most practical manner.*

EXERCISE 2.—*Bisect all the angles of a scalene triangle.*

These lines, like those of Exercise 2*b*, Section E, meet in one point. Show that this point is equidistant from the three sides, and then describe the circle which touches the three sides of the triangle internally.

It would be instructive and interesting to collect now all the cases we have had of lines connected with triangles which pass through a common point.

EXERCISE 2a.—*Describe a circle in a triangle, omitting all unnecessary lines.*

Exercise 2a should be followed by the description of a circle to touch two sides of the same triangle produced, and the third side of the triangle externally. By joining the centres of these two circles we may show that this line (which bisects one of the angles of the triangle) is the *locus* of the centres of all circles touching two lines which enclose an angle.

EXERCISE 3.—*Inscribe a circle in an isosceles triangle.*

EXERCISE 3a.—*Divide a square into four equal isosceles triangles by drawing the diagonals, and inscribe a circle in each triangle.*

Now describe a circle touching (and enclosing) these four smaller circles. Use this figure to enable you to work the following exercises:—

EXERCISE 3*b*.—*Place a circle in a sector so as to touch the two radii and the arc.*

EXERCISE 3*c*.—*Place four equal circles in a circle, touching each other and the circle.*

Try also to inscribe five, six, eight, etc., circles in a circle, first dividing up into sectors by equidistant radii, and converting one sector into an isosceles triangle, in which the circle is really placed, as shown in Fig. 5.

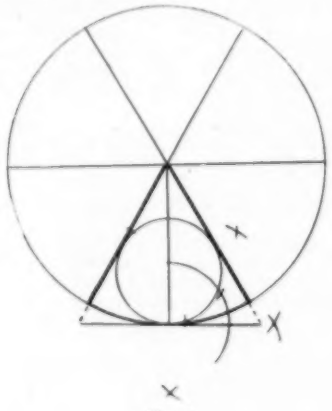


FIG. 5.

EXERCISE 4.—*Take a figure like that of Exercise 3a, Section C—that is, two dissimilar isosceles triangles base to base.*

Bisect two adjacent angles. This gives the centre of the inscribed circle.

EXERCISE 4a.—*Divide an equilateral triangle up into such figures as that of Exercise 4 by medians.* (See ABCD, Fig. 6.) *Then inscribe a circle in each.*

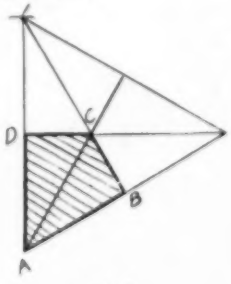


FIG. 6.

Note that the symmetry of the figure simplifies the construction, for, having found one centre, the others are easily got.

EXERCISE 4*b*.—*Divide a hexagon also into similar figures (by diameters and diagonals), and inscribe circles in each.*

Compare the result with that got by inscribing circles in the triangles, which have the sides of the polygons for their bases.

These series of examples illustrate well what is intended, in fact, to be shown by the scheme as a whole, how many of the more complicated problems can be built up by such easy stages as may be intelligible to any average boy or girl.

EXERCISE 5.—*Use Problem* VII. *to obtain from an angle of* 90°, *one of* 45°, *and also one of* 22½°. *Repeat the process as long as possible, taking rather a large figure, and thus obtain a very small angle, say, about* 2°. *Obtain also, by subdivision of an angle of* 60°, *angles of* 30°, 15°, 7½°, *and so inscribe in a circle figures of* 12, 24, 48 *sides.*

Notice that unless the circle is very large, the sides nearly coincide with the circle when the number gets large.

Construction and Use of a Protractor.

EXERCISE 6.—*Describe a semicircle on a line* 4 *in. long; divide the arc into three equal parts. Bisect each of these, and then by trial divide each of these parts into three equal arcs. How many degrees have we in each arc?*

If we join each point to the centre of the diameter we shall have a series of angles which will be multiples of 10°. By dividing these again into halves we shall get angles of 5°. Number the divisions in some convenient way. Draw very carefully, and then cut out the figure.

This can be used to construct angles of various sizes; and we can now inscribe in a circle regular polygons with an odd number of sides—for instance, a pentagon. The angular space round a circle contains 360°. This must be divided into five equal parts, each containing 72°. Try to divide the space up in this way by equidistant radii.

EXERCISE 7.—*Construct a compass card, and letter it with the principal points.*

EXERCISE 8.—*Take an isosceles triangle, as in Fig.* 7. *Bisect the right angles at D, and obtain the half square EDF. Describe a semicircle round it, as shown. Use this to describe a series of semicircles in an equilateral triangle, square, hexagon, etc., first dividing them up into isosceles triangles by lines drawn from the centre of the figure to the angular points; also to construct a semicircle in a sector* (*as shown in Fig.* 7), *and then* 3, 4, 5, 6, *etc., in a circle, and tangential to the circle.*

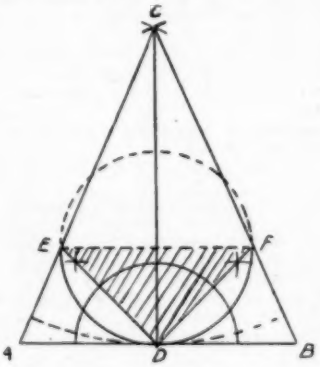


FIG. 7.

SEVENTY-SIX YEARS' SERVICE.—We recently read an account in the *Manuel Général* of a lady, Madame Cavelier, who is now in her ninety-fourth year, and has spent no less than seventy-six years in teaching. Her life is described by one who knows her as one long uninterrupted kind action—"Elle fait le bien comme on respire." No wonder our French colleagues are proud of their *doyenne*, and have appealed to the President of the republic to grant her the Cross of the Legion of Honour.

BAD LANGUAGE.—In few respects is the spread of education more evident than in the great decrease of bad language used. Formerly it was almost impossible to go through the streets without having one's ears assailed by oaths and strong language; and frequently the objectionable words were used not as the outcome of evil intentions, but simply from poverty of vocabulary. Now one can spend hours in quite the poorest parts of our great cities without hearing an objectionable remark; and we are informed that at a recent meeting of the South London Cabmen's Association a resolution was unanimously passed expressing horror of bad language, especially in public places, and calling upon all cabmen to discountenance and suppress the evil practice.

THE INSPECTOR'S NOTEBOOK.

BY AN INSPECTOR OF SCHOOLS.

Holiday Courses for Teachers. My notes this month will find most of you holiday-making. I often think it is a pity that most of the schools should be closed during August. This is more because it is the custom than for any other reason, I fancy. The great disadvantage is that a holiday in August costs so much more than one in June or September. Many teachers, not always wisely, spend their holidays in visiting schools, or in attending courses of instruction on the Continent. Ambition is a good quality, but most teachers owe it to themselves and their connections to take some rest in the long vacation. My remarks refer more especially to those no longer in the heyday of youth. It is undoubtedly a bad habit to get into—to regularly rob oneself of the much-needed repose of which the summer holidays allow. Let it be clearly understood that all who attend the courses I refer to have to work very hard during hot weather if they wish to profit by the lectures. If you have a long holiday, and can finish up with two or three weeks' absolute rest afterwards, then there is less objection.

Again, courses of instruction in manual work are less objectionable than those of a sedentary and bookish nature. A course of practical gardening lessons would be, generally speaking, open to the least objection, because of its outdoor nature and complete change.

A Rational Method of Improving the Teacher. I have a suggestion to offer relative to this matter of self-improvement of teachers. It is certain the County Councils will make an early start in the direction of producing a better-equipped class of teacher. With regard to those now in the profession, I think arrangements might be made, where necessary, for all desirous of attending to be excused by their managers. Suppose, for example, it is thought advisable to have lectures on Freearm Drawing in a particular county. Let the county employ a specialist, who shall hold classes at two or three convenient centres. The schools near a centre might either be closed for the week or fortnight, or a substitute provided for the time in the case of all teachers willing to avail themselves of the advantage.

The Punishment Book. There is no mention of this book in the Provisional Code for 1903, which means that the Board of Education no longer require a record of punishments to be kept. Any managers who wish may, of course, instruct their teachers to keep punishment books, but they must themselves see that their instructions are carried out. The Government Inspector will no longer have any *locus standi* in the matter of punishment records. The Board of Education still regards corporal punishment as a thing to be discouraged. No school where there is an excessive use of the cane can be regarded as a good one. An inspector may still inquire respecting the amount of corporal punishment, but may not insist on a record being kept.

I have made these remarks to clear the atmosphere somewhat, as I have found some who thought the omission of the reference in the Code implied that their punishment was to be above inquiry.

Environment: A Clean School. In quite a large number of schools I find insufficient attention given to the cleaning arrangements. Even medically, nowadays, much greater stress is laid on environment than on any other factor. It is highly essential that hygienically we should see that the child's surroundings are sound. If cobwebs, dust, and dirt are to be found in, say, a girls' school, then what will be the standard of cleanliness in the homes of the next generation? Often the school windows are dirty, and the pictures and ledges just above the eye-line are thick with dirt. Rarely do I find a waste-paper basket in a school, or a wire receptacle for the litter of the playground. There are several reasons for this state of things. The chief is that insufficient payment is forthcoming. The next is that the caretaker has no definite master over him to see that he executes his duties. A small School Board contents itself frequently by preparing a long list of the duties, which often is hung up in the school. It would be better if there were fewer duties and more supervision. I fancy the arrangements will be more effectual after the "appointed day." The schoolroom should be, in most respects, a model home. There should be a few chairs for visitors, and pegs upon which to hang their hats and coats.

The Separate Time-Table for Babies. I have before written of the advisability of having an entirely separate time-table for the babies in an infant school. To be practical, I propose to give you a suggested one:—

9.15 to 9.20.	Assembly and disrobing, always under the supervision and with the help of a teacher.
9.20 to 9.30.	Inspection of hands, boots, etc., marching, registration.
9.30 to 9.50.	Singing of hymn and Scripture.
9.50 to 10.	Drill.
10 to 10.15.	Number, by aid of cockle or cowrie shells.
10.15 to 10.30.	Recreation in playground.
10.30 to 10.50.	Letters, by aid of something concrete.
10.50 to 11.10.	Writing in sand.
11.10 to 11.25.	Object lesson.
11.25 to 11.45.	Varied occupations.
11.45 to 11.55.	Robing and dismissal.
2 to 2.15.	Assembly, inspection of hands, marching, registration.
2.15 to 2.30.	Number taught in the concrete.
2.30 to 3.	Needle drill (girls), drawing (boys)—Mon., Wed., Fri. Drawing (boys and girls)—Tu., Th.
3 to 3.15.	Recreation.
3.15 to 3.30.	Recitations or picture lesson.
3.30 to 3.45.	Kindergarten game.
3.45 to 4.	Robing.
4.	Prayers, dismissal.

There ought to be in every school plenty of simple picture books. These should be given out to the children occasionally in the picture lesson. They are also very useful for amusing the new scholars until they become accustomed to the usual routine.

If you have no separate playroom for babies, you should, whenever the weather is favourable, take them into the playground for the drill and game lessons.

In most schools beans or shells are used for teaching numbers. It is advisable for babies to use large shells. Some of the cowrie shells are very small, and I have known them pushed into the ears and nose. Form and colour may be taken one morning from 11.10 to 11.25 in lieu of the object lesson.

Above all, cultivate freedom with the babies. You must not be strict, or you will never get on good terms with them. Treat them more like your family than like a class in school. Let them talk as much as they wish to you. In fact, encourage them to talk to you, and to tell you about themselves and their little worlds.

Composition. Composition is not always free enough. There should be a proper gradation of work for all the standards, and we should give full scope for the originality of our scholars. We are too prone to give the children model sentences and typical essays to copy. Again, even in higher standards, composition often merely means making up some sentences orally from single disconnected words. I am a great believer in teaching through the concrete, wherever possible; therefore I should almost invariably use an object or a good picture in the lower standards. Very occasionally I should allow a class to copy from the board some connected sentences given orally by the class. Another danger with this subject is the tendency for it to develop too much into a grammar lesson *per se*.

THE "NOTEBOOK" QUERY COLUMN.

Letters intended for this column should be addressed "Inspector," care of Editor, PRACTICAL TEACHER. Only in very urgent cases can replies be sent by post, and then only when two stamps accompany the letter.

EXHIBITION OF BRITISH ENGRAVING AND ETCHING.—As the collection of examples of British engraving and etching brought together in the galleries of the India Section of the Victoria and Albert Museum continues to attract many visitors, the Board of Education have arranged that it shall remain open until the 30th September next.

A PRACTICAL LESSON IN GEOGRAPHY.

SKETCHING DISTRICT MAPS.

BY R. AINSWORTH.

THE sketching of district maps finds a place in every good scheme of nature study, and considering the number of teachers who are introducing nature study into their schools, the following notes will be useful. It is not intended to give here elaborate instructions for the making of maps, such as are observed by those employed in the ordnance survey, but only such instructions as will enable children to make a fairly accurate map of the district in which they live, or with which they are familiar.

By a district map is here meant a map of any district in which the children have carried on their observations. The map may represent no larger tract of country than a public park, recreation ground, or country lane with its adjacent fields; or it may be made to represent a country village with its surrounding stretch of country.

Scales.

Before making a map of any district, it is necessary to decide on the scale to be employed in its construction. By a scale is meant the proportion between the real size of the country represented and the size of the map which is drawn. Thus a stretch of country 2 miles long and 1 mile wide may be represented on a piece of paper 2 inches long and 1 inch wide. In such a case the scale would be 1 inch to 1 mile, and the map would be $\frac{1}{63360}$ the size of the country it represents.

Again, a stretch of country 1 mile long may be represented by a map 1 yard long. In such a case the map would be drawn to a scale of 1 yard to 1 mile, and would be $\frac{1}{1760}$ the size of the country it represents.

Representative Fraction.

Each of the fractions $\frac{1}{63360}$ and $\frac{1}{1760}$ is called the representative fraction. The numerator of a representative fraction is always unity. The denominator shows the number of inches, feet, or yards on the ground which the numerator represents on paper. Thus R.F. $\frac{1}{63360}$ means that 63,360 inches (1 mile) on the ground are represented by 1 inch on paper; and R.F. $\frac{1}{1760}$ means that 1760 yards (1 mile) on the ground are represented by 1 yard on paper. It is important to remember that the numerator and denominator of a representative fraction always represent the same—that is, both represent yards or feet, etc.

It is important that both the representative fraction and the scale should be placed on a sketch. By means of the former the proportion which a certain distance on paper bears to the ground which it represents can be seen at a glance. By means of the latter, any one using the sketch can measure distances between places readily and easily.

Construction of Scales.

A scale is generally made about 4 or 6 inches long, and is then graduated so as to show various distances.

EXAMPLE 1.—*Construct a scale of 1 inch to 100 yards.*

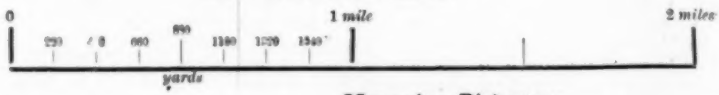
Here the R.F. will be $\frac{1}{100 \times 36} = \frac{1}{3600}$.

The scale will be as follows:—

EXAMPLE 2.—*Construct a scale of 2 inches to 1 mile.*

Here the R.F. will be $\frac{2}{63360} = \frac{1}{31680}$.

The scale will be as follows:—



Measuring Distances.

It will be necessary to measure certain stretches of country. This can be done by means of the chain (22 yards), tape measure, or, when only a very rough sketch is required, by means of paces.

How to find the true North.

It will also be necessary, before proceeding to make the sketch, to find the true north. As the point of a compass does not point to the true north, the true north can be found by the following method.

Fix a stick perfectly upright on a level piece of ground. When the sun shines the stick will cast a shadow. At twelve o'clock this shadow will point to the north.

Field Book.

A field book is also necessary. In this book measurements similar to those made by land-surveyors must be entered. Each page is divided into three columns (as shown in Fig. 1), the central column being called the chain column.

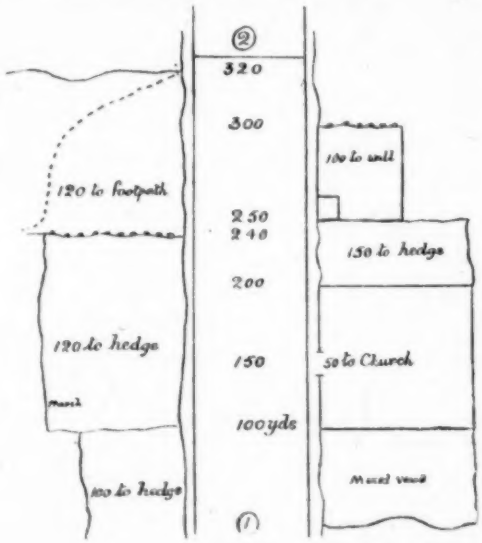


FIG. 1.

In this column are entered the measurements made when moving forward. At each station a line should be drawn across the central column, and the station marked by a number surrounded by a circle. When making entries in the field book, commence at the bottom of the last page and work upwards.

Fig 1 shows the entries on a page of a field book, and Fig. 2 shows the sketch made from these entries.

We have made no mention of the prismatic compass and other instruments needed in making a very accurate survey of a district. Sufficient instructions, however, have been given to enable children to make fairly accurate maps.

Definitions.

A *hillock* is a little hill, a *knoll* a low, round hill.

A *col* is a neck joining two hills or mountains.

A *saddle* is the rise and fall on the ridge of a hill, and is like a saddle in shape.

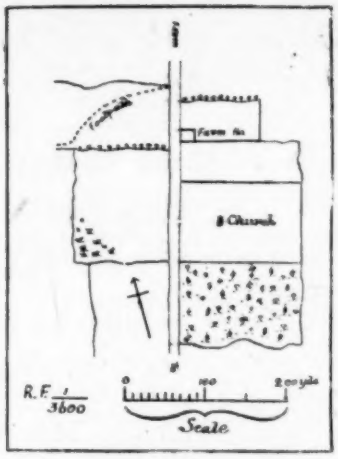


FIG. 2.

A *spur* is a mountain or mountain mass that projects from another mountain mass, and extends for some distance.

A *watershed* is the ridge of land which divides the basins of two rivers. It is generally formed by a line of hills or mountains.

A *valley*, *vale*, or *dale* is the low land lying between two ranges of hills.

A *gorge* or *ravine* is a deep, narrow valley.

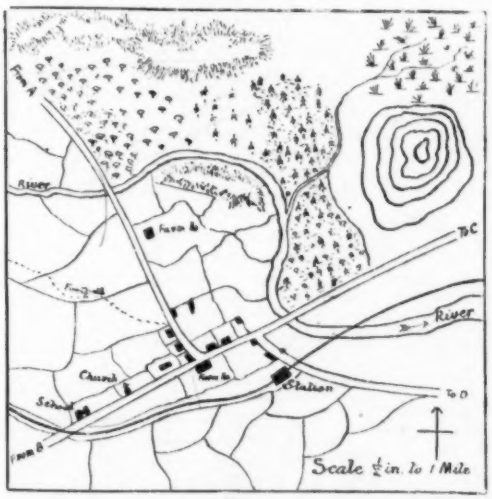


FIG. 3.

A *bridle-path* or *bridle-road* is a path or road which can be travelled on horseback, but not by wheeled carriages.

The *beach* is that part of the shore which is washed by the tide.

Conventional Signs used in Map-Drawing.

Railways, etc.—Railways are generally denoted by a continuous black line. Where part of a railway line is single and part double, the words "single" and "double" are inserted to indicate such parts.

A tunnel is indicated by means of a broken line. The various other features connected with railways (cutting, railway over railway, road over railway, road under railway, station, level crossing, and embankment) are indicated as shown in the accompanying illustrations.

A tramway is indicated by means of a continuous black line with short lines crossing it at right angles.

Roads, etc.—Roads are denoted by means of two parallel lines.

A footpath or bridle-path is denoted by means of a broken line.

Rivers, etc.—Rivers are represented by a single line when

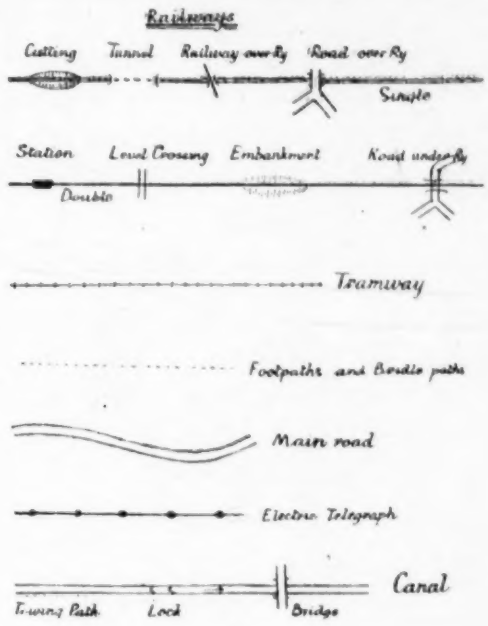


FIG. 4.

they are small, and by a double line when they widen out and become navigable.

Bridges, ferries (foot-passengers), and fords (vehicles) are indicated as shown in the accompanying illustrations.

Canals are represented by parallel lines.

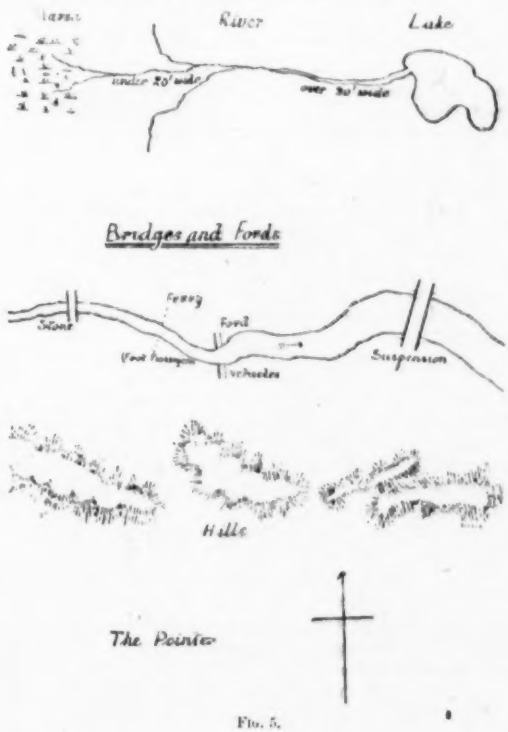


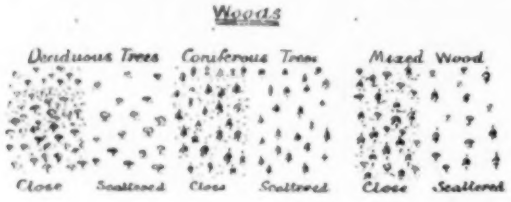
FIG. 5.

Hills.—Hills are denoted by "hachure" lines as shown in the illustrations.

Contours.—Hills are also represented by contours—imaginary lines running round a hill. Contour lines indicate whether the slopes of hills are gentle or steep. The nearer together two contours are on the map, the steeper is the slope at that particular point. Instruments, such as the clinometer, theodolite, etc., are required to put contour lines in accurately. For ordinary sketches, however, the contours may be judged.

In a sketch the contours are usually shown by thin red lines.

Woods.—Deciduous trees, coniferous trees, and mixed



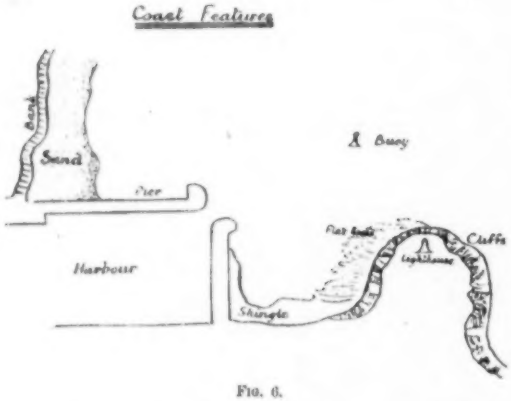


FIG. 6.

woods are indicated as shown in the accompanying illustrations. Care must be taken to indicate whether the trees are close or scattered.

Colouring.

If colour is put over ordinary writing ink, the latter will "run." Sketches which are intended to be coloured should therefore be made with Indian ink. The following are the only colours which will be required: Main roads, burnt sienna; rivers, Prussian blue; cultivated tracts, gamboge; woods, green.

Only light washes of each colour should be put upon the sketch.

SUCCESS OF LONDON COUNTY COUNCIL SCHOLARS AT GIRTON COLLEGE, CAMBRIDGE.—For the second year in succession the clothworkers' scholarship of £60 a year for natural science at Girton College, Cambridge, which is awarded on the result of a competition open to all England, has been obtained by a girl who commenced her education in a London Board School, and who obtained first a junior county scholarship, and then an intermediate county scholarship. Last year the successful scholar was Ellen Delf, who commenced her education at Goodrich Road Board School; this year the successful scholar is Mabel Gardiner, who commenced her education at Gipsy Road Board School. Both girls, on gaining their junior scholarships, joined the James Allen's School, Dulwich, where they continued for five years with the aid of the Board's scholarships. Both gained the Girton science scholarship direct from the school.

RECITATION FOR STANDARD I.

(To be learned after the story of the Sleeping Beauty has been told.)

MY SLEEPING BEAUTY.

HERE'S my Sleeping Beauty
Sleeping in the ground,
While the winter tempest
Rages round and round.

O'er her head a mantle,
Pure and deep and white,
She lies warm and cosy,
Sleeping day and night—

Sleeping, ever sleeping,
While the trees are bare,
And the frosty jewels
Glisten everywhere.

While the birds are silent
And the sun is red,
While the moon is shining
As I go to bed,

While the flowing river
Firm with ice is bound,
And the days are dreary,
She is sleeping sound.

But the Prince is coming—
Coming with the Spring,
Like a shaft of sunlight,
Blessing everything.

My lady in her chamber
He will swiftly seek,
And will kiss her lightly
On her pale, soft cheek.

Then my Sleeping Beauty
Will awake and rise,
Go forth from her slumber,
Look up to the skies;

See the white clouds sailing,
Feel the gentle breeze,
Hear the sweet birds piping
In the budding trees;

Turn with eyes a-glowing
To the Prince so fair,
Daily grow in beauty
'Neath his tender care.

She will grace my garden
In the summer hours,
Blush and smile so sweetly
As a QUEEN OF FLOWERS.

EDWARD SHIRLEY.

HOLIDAY RESORTS AND RECOMMENDED ADDRESSES.—This useful little booklet volume now appears in its twentieth annual issue, and is corrected to February 1903. The addresses have been collected and revised by a Holiday Resorts Committee, consisting of ladies and gentlemen more or less well known in the educational world. The sections under which the fullest information is given as to terms, accommodation, etc., are England, Wales, Scotland, and Ireland. All parts of the continent of Europe are also fully dealt with, and, in addition, there are particulars relative to Africa, U.S.A., West Indies, and Australia. It is an invaluable little book, and worth five times the price charged for it. A copy may be obtained for 1s. 1d. upon application to the Teachers' Guild, 74 Gower Street, W.C.

OUR QUERY COLUMN.

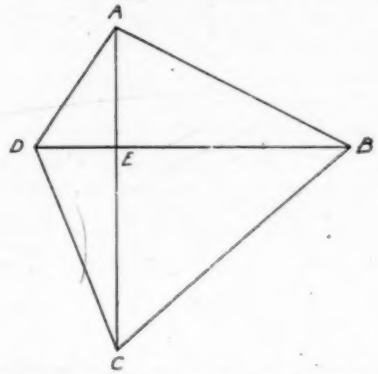
RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the name and address of the correspondent, and the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

Bat.—(1) Find an expression for the area of a convex quadrilateral which has its diagonals equal in length and also at right angles. If A, B, C, D be the angles in order, prove that

$$\frac{1}{\cot A - 1} + \frac{1}{\cot C - 1} = \frac{1}{\cot B - 1} + \frac{1}{\cot D - 1}.$$



Let the diagonals intersect at right angles at E, and let $AC = BD = l$.

Let $DE = p$, $EB = q$, $CE = r$, $EA = s$.

Then $(p + q) = (r + s) = l$.

Also denote $\angle BAE$ by a_1, $\angle DAE$ by a_2, $\angle CBE$ by β_1, $\angle ABE$ by β_2, $\angle DCE$ by γ_1, $\angle BCE$ by γ_2, $\angle ADE$ by δ_1, and $\angle CDE$ by δ_2.

Twice area of ABCD $= ps + qs + pr + qr$
$= s(p + q) + r(p + q)$
$= (p + q)(r + s) = l^2$.

$\therefore$ area of ABCD $= \frac{1}{2} \cdot l^2$.

$$\text{Cot A} = \cot(a_1 + a_2) = \frac{\cot a_1 \cot a_2 - 1}{\cot a_1 + \cot a_2} = \frac{\frac{s^2}{pq} - 1}{\frac{s}{q} + \frac{s}{p}} = \frac{s^2 - pq}{s(p + q)}.$$

$$\therefore \cot A - 1 = \frac{s^2 - pq - qs - sp}{s(p + q)} = \frac{s^2 - pq - sl}{sl}.$$

Similarly, $\cot C - 1 = \frac{r^2 - pq - rl}{rl}$, $\cot B - 1 = \frac{q^2 - rs - ql}{ql}$,

and $\cot D - 1 = \frac{p^2 - rs - pl}{pl}$.

Hence

$$\frac{1}{\cot A - 1} + \frac{1}{\cot C - 1} = \frac{sl}{s^2 - pq - sl} + \frac{rl}{r^2 - pq - rl}, \quad . \quad (1)$$

and

$$\frac{1}{\cot B - 1} + \frac{1}{\cot D - 1} = \frac{ql}{q^2 - rs - ql} + \frac{pl}{p^2 - rs - pl}. \quad . \quad (2)$$

Taking the right-hand side of (1), we have—

$$\frac{sl}{s^2 - pq - sl} + \frac{rl}{r^2 - pq - rl} = \frac{l(sr^2 - pqs - rsl + rs^2 - pqr - rsl)}{(s^2 - pq - sl)(r^2 - pq - rl)}$$

$$= \frac{l\{rs(r + s) - pq(r + s) - 2rsl\}}{r^2s^2 - r^2pq - r^2sl - pqs^2 + p^2q^2 + pqsl - rs^2l + prql + rsl^2 - l^2(pq + rs)}$$

$$= \frac{l\{rs(r + s) - pq(r + s) - 2rsl\}}{r^2s^2 - r^2pq - rsl(r + s) + rsl^2 + p^2q^2 + pql(r + s) - pqs^2 - l^2(pq + rs)}$$

$$= \frac{-l^2(pq + rs)}{r^2s^2 - pq(r^2 - pq - l^2 + s^2)} = \frac{-l^2(pq + rs)}{r^2s^2 - pq(-pq - 2rs)}$$

$$= \frac{-l^2(pq + rs)}{r^2s^2 + 2pqrs + p^2q^2} = \frac{-l^2(pq + rs)}{(pq + rs)^2} = \frac{-l^2}{pq + rs}.$$

Taking the right-hand side of (2), we have—

$$\frac{ql}{q^2 - rs - ql} + \frac{pl}{p^2 - rs - pl} = \frac{l(p^2q - qrs - pql + pq^2 - prs - pql)}{(q^2 - rs - ql)(p^2 - rs - pl)}$$

$$= \frac{l\{pq(p + q) - rs(p + q) - 2pql\}}{p^2q^2 - p^2sr - p^2ql - rsq^2 + r^2s^2 + qrsl - pq^2l + prsl + pql^2 - l^2(pq + rs)}$$

$$= \frac{-l^2(pq + rs)}{p^2q^2 - pql(p + q) + pql^2 - rs(p^2 + q^2 - rs - l^2)}$$

$$= \frac{-l^2(pq + rs)}{p^2q^2 - rs(-rs - 2pq)} = \frac{-l^2(pq + rs)}{p^2q^2 + 2pqrs + r^2s^2} = \frac{-l^2}{pq + rs}.$$

It follows, therefore, that

$$\frac{1}{\cot A - 1} + \frac{1}{\cot C - 1} = \frac{1}{\cot B - 1} + \frac{1}{\cot D - 1}.$$

(2) See C. Smith's *Treatise on Algebra*, § 287.

Ruscus.—If a plate of iron, one foot square and one inch thick, is capable of transmitting 7·5 British thermal units (pound degree Fahr.) per minute, when the difference between the temperatures of its opposite faces is 1° F., find the conductivity in the Centigrade system in C.G.S. units.

(1 lb. = 453·6 grams; 1 in. = 2·54 cms.)

(Board of Education, Adv. Heat, 1903.)

1 B.T.U. will raise the temperature of 1 lb. of water through 1° F. It will therefore raise the temperature of 453·6 grams of water through $\frac{5}{9}$ of a Centigrade degree.

$$\therefore 1 \text{ B.T.U.} = \frac{453{\cdot}6 \times 5}{9} = 252 \text{ gram calories.}$$

1 sq. ft. $= (12 \times 2{\cdot}54)^2$ sq. cms.
$= 929$ sq. cms.

$\therefore$ heat transmitted per sq. cm. per sec.

$$= \frac{7{\cdot}5 \times 252}{929 \times 60} = 0{\cdot}0337 \text{ gram calories.}$$

Temperature gradient = 1° F. per inch = $\frac{5}{9}$° C. in 2·54 cms.
= 0·219° C. per cm.

$$\therefore \text{conductivity of iron} = \frac{0{\cdot}0337}{0{\cdot}219} = 0{\cdot}156.$$

A.C.P.—In a trihedral angle two of the plane angles and their included dihedral angle are given. Determine by descriptive geometry the third plane angle and the other two dihedral angles.

The solution is given in full in any of the larger works on descriptive geometry. See Millar's *Descriptive Geometry* (Macmillan), p. 100.

Ciris.—Solve the equation $p^3 + x^3 = axp$.
(Forsyth's *Differential Equations.*)

Put $p = xz$. . . . . (1)

$\therefore x^3(z^3 + 1) = ax^2z$.

$\therefore x = \frac{az}{z^3 + 1}$. . . . . (2)

And from (1), $p = \frac{az^2}{z^3 + 1}$. . . . . (3)

But $p = \frac{dy}{dx} = \frac{dy}{dz} \cdot \frac{dz}{dx} = \frac{dy}{dz} \cdot \frac{(z^3 + 1)^2}{a(1 - 2z^3)}$. . . . . (4)

from $\frac{dx}{dz}$ from (2).

Equating the values of p in (3) and (4), we obtain—

$$\frac{dy}{dz} = a^2\frac{(1 - 2z^3)z^2}{(z^3 + 1)^3}.$$

Integrating, we have

$$y + c = \frac{a^2}{6} \cdot \frac{1 + 4z^3}{(1 + z^3)^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

The solution of the given equation is to be obtained by eliminating z from (2) and (5). Or (2) and (5) together may be said to give the solution.

Testing the given equation for a singular solution, we have— $\phi \equiv p^3 - axp + x^3 = 0$. . . . . (6)

$$\frac{\partial\phi}{\partial p} = 3p^2 - ax = 0. \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

$$\therefore p = \frac{a^{\frac{1}{2}}}{3^{\frac{1}{2}}} x^{\frac{1}{2}} \text{ from (7).}$$

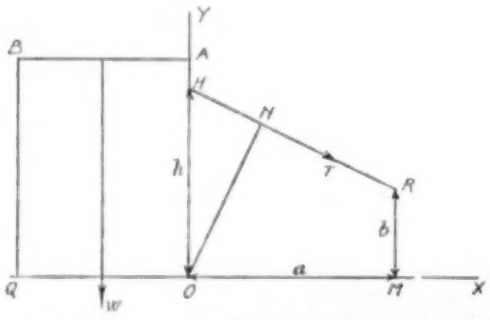
Inserting in (6), we have—

$$\frac{a^{\frac{3}{2}}}{3^{\frac{3}{2}}} x^{\frac{3}{2}} - \frac{a^{\frac{3}{2}}}{3^{\frac{1}{2}}} x^{\frac{3}{2}} + x^3 = 0.$$

$$\therefore x = 4\frac{1}{3} \cdot a. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

The value of p from (8) is infinite, and these values of p and x do not satisfy (6). There is no singular solution, and (8) is a cuspidal locus.

L.C.P.—A man wishes to overturn an upright cylinder, standing on a horizontal plane, by means of a string which is attached at a point of the cylinder and passes through a smooth ring. The ring is fixed at a height b above the horizontal plane, and at a horizontal distance a from the surface of the cylinder. If the magnitude of the tension be the least possible, prove that the point of the cylinder to which the string is attached is $\frac{a^2 + b^2}{b}$ above the horizontal plane.



Let QOAB be the section of the cylinder made by the vertical plane which passes through the axis of the cylinder and the position of the ring R.

Let the string be attached at a point H in OA. From O draw ON perpendicular to the string HR, and let the length of ON be denoted by p. Then if W be the weight of the cylinder, r its radius, and T the magnitude of the tension of the string, on taking moments about O, we have for equilibrium

$$Wr = Tp.$$

Since Wr is constant, T is least when p is greatest. Hence we have to find for what value of OH p is greatest. Denote the length OH by h. Taking O as origin, QO produced as axis of x, and OA as axis of y, the equation of the line HR is $y + \frac{h - b}{a}x = h$, or $(h - b)x + ay = ah$. Hence the square of the perpendicular from O upon HR,

$p^2 = \frac{a^2h^2}{(h - b)^2 + a^2}$. Denoting p^2 by u, we have—

$u = \frac{a^2h^2}{(h - b)^2 + a^2}$, and we have to determine for what value of h, u is a maximum.

$$\frac{du}{dh} = \frac{\{(h - b)^2 + a^2\}2a^2h - 2a^2h^2(h - b)}{\{(h - b)^2 + a^2\}^2}.$$

Hence we deduce that u is a maximum when—

$2a^2h\{(h - b)^2 + a^2\} = 2a^2h^2(h - b)$;

that is, when $(h - b)^2 + a^2 = h(h - b)$;

that is, when $h^2 - 2bh + b^2 + a^2 = h^2 - hb$;

that is, when $hb = a^2 + b^2$;

or $h = \frac{a^2 + b^2}{b}$.

Hence it follows that p is greatest when $h = \frac{a^2 + b^2}{b}$; and, therefore, when the magnitude of the tension of the string is the least possible, OH $= \frac{a^2 + b^2}{b}$.

Carret.—If the cost price of an article is reduced by 1·25 francs per kilo., the profit per cent. will be doubled; but if the sale price is reduced at the same time by 6d. per lb., the profit per cent. will be unaltered. Determine the sale price of the article in shillings per pound.

(1 kilo. = 2·2 lbs.; £1 = 25 francs.)

Note.—No credit will be given for an algebraical solution.

1·25 francs per kilo. = 1s. per kilo. = 12d. per 2·2 lbs. $= \frac{60}{11}$d. per lb.

Now, by the question, a fall of 6d. per lb. in the sale price and a simultaneous fall of $\frac{60}{11}$d. per lb. in the cost price have no effect on the profit per cent. Hence 6d. per lb. represents the same fraction of the sale price as $\frac{60}{11}$d. per lb. does of the cost price; and since any fraction whatever of the whole will gain as much profit *per cent.* as the whole does, therefore—

$$\frac{6 - \frac{60}{11}}{\frac{60}{11}} \times 100 \text{ is the profit per cent.}$$

This works out to $100 \times \frac{66 - 60}{60}$ per cent., or *ten per cent.*

Again, by the question, we see that 6d. per lb. is equivalent to 10 per cent. of the reduced cost price. Hence the reduced cost price is 10 × 6d. per lb., or 5s. per lb.

Finally, by the question, the original sale price is 20 per cent. more than the reduced cost price. Hence the original sale price is $\frac{120}{100} \times 5$s. per lb., *or 6s. per lb.*

Scotty.—Find (by means of general rules, and not by simple trial) what numbers consisting of the four digits 3, 4, 5, and 6 are divisible by 396.

Since an odd number is not divisible by an even number, we have only to consider the numbers ending in 4 and those ending in 6. Now the number of permutations of the digits 3, 4, 5, and 6, when the last digit is 6, is $1 \times 2 \times 3$, that is 6. The six numbers ending in 6 are therefore 3456, 4356, 4536, 5436, 5346, and 3546. Similarly, the six numbers ending in 4 are 3564, 5364, 3654, 6354, 5634, and 6534.

Now, $396 = 11 \times 3 \times 3 \times 2 \times 2$. Of the foregoing twelve numbers only four—namely, 4356, 5346, 3564, and 6534—are divisible by 11. Hence the other numbers are not divisible by 396 (which we have shown to be a multiple of 11). Of the remaining four numbers—

$4356 = 11 \times 11 \times 9 \times 4$
$5346 = 11 \times 3 \times 3 \times 3 \times 3 \times 3 \times 2$
$3564 = 11 \times 3 \times 3 \times 3 \times 3 \times 2 \times 2$
$6534 = 11 \times 11 \times 3 \times 3 \times 3 \times 2$.

Now, of these, only 4356 and 3564 are divisible by $11 \times 3 \times 3 \times 2 \times 2$, or 396.

Hence of the numbers consisting of the four digits—3, 4, 5, and 6—only 3564 and 4356 are divisible by 396.

Rex—Eliminate m, n, and θ from the equations—

$$m \sin \theta - n \cos \theta = \sin \alpha \cos \theta. \quad . \quad . \quad . \quad (1)$$

$$m \cos \theta + n \sin \theta = \sin \alpha \sin \theta. \quad . \quad . \quad . \quad (2)$$

$$\frac{x}{\cos \alpha} = \frac{y - a \cos \theta}{m}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$\frac{x}{\cos \alpha} = \frac{z - a \sin \theta}{n}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Multiplying (1) by $\cos \theta$, and (2) by $\sin \theta$, we have—

$$m \sin \theta \cos \theta - n \cos^2 \theta = \sin \alpha \cos^2 \theta. \quad . \quad . \quad (5)$$

$$m \sin \theta \cos \theta + n \sin^2 \theta = \sin \alpha \sin^2 \theta. \quad . \quad . \quad (6)$$

Taking (5) from (6)

$$n = \sin \alpha (\sin^2 \theta - \cos^2 \theta), \therefore n = -\sin \alpha \cos 2\theta. \quad . \quad (7)$$

Again, multiplying (1) by $\sin \theta$, and (2) by $\cos \theta$, we have—

$$m \sin^2 \theta - n \sin \theta \cos \theta = \sin \alpha \sin \theta \cos \theta. \quad . \quad (8)$$

$$m \cos^2 \theta + n \sin \theta \cos \theta = \sin \alpha \sin \theta \cos \theta. \quad . \quad (9)$$

Adding (8) to (9)

$$m = \sin \alpha \sin 2\theta. \quad . \quad . \quad . \quad . \quad . \quad . \quad (10).$$

Substituting for m in (3), and for n in (4), we have—

$$x \tan \alpha \sin 2\theta = y - a \cos \theta. \quad . \quad . \quad (11)$$

$$x \tan \alpha \cos 2\theta = a \sin \theta - z. \quad . \quad . \quad . \quad (12)$$

It remains to eliminate θ between (11) and (12).

Multiplying (11) by $\sin \theta$, and (12) by $\cos \theta$, we have—

$$x \tan \alpha \sin 2\theta \sin \theta = y \sin \theta - a \sin \theta \cos \theta. \quad . \quad (13)$$

$$x \tan \alpha \cos 2\theta \cos \theta = -z \cos \theta + a \sin \theta \cos \theta. \quad (14)$$

Adding (13) and (14), we have—

$$x \tan \alpha \cos \theta = y \sin \theta - z \cos \theta. \quad . \quad . \quad (15)$$

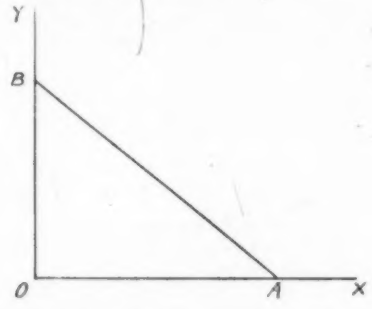
$$\text{Hence } \tan \theta = \frac{x \tan \alpha + z}{y}. \quad . \quad . \quad . \quad (16)$$

From (16) we may express $\sin^2 \theta$ in terms of a, x, y, and z. Then writing (12) in the form

$$z + x \tan \alpha (1 - 2 \sin^2 \theta) = a \sin \theta,$$

squaring, and substituting the value of $\sin^2 \theta$ obtained from (16), we eliminate θ.

Cymro.—Two particles A and B are moving along lines which meet at right angles at O. One is approaching and the other receding from O. If at each moment their velocities are inversely in the ratio of their distances from O, prove that the distance between them is constant.



Let OX, OY be the lines along which the particles are moving, B approaching and A receding from O. At any instant let OA = x, and OB = y. Then, by the question, we have—

$$\frac{dx}{dt} = \frac{\mu}{x}, \text{ and } \frac{dy}{dt} = \frac{-\mu}{y}, \text{ where } \mu \text{ is some constant.}$$

$$\therefore x\,dx + y\,dy = (\mu - \mu)dt = 0.$$

Integrating, we have—

$$\tfrac{1}{2}x^2 + \tfrac{1}{2}y^2 = \text{constant.}$$

$$\therefore x^2 + y^2 = \text{constant.}$$

$$\text{Hence } (AB)^2 = \text{constant,}$$

therefore the distance between the particles A and B is constant.

Siren.—Define a simple vibration. Show by a diagram how to exhibit the result of adding together two simple vibrations of different frequencies.

From any text-book on physics it will be found that all the simple periodic vibrations that present themselves in physics, whether referring to acoustics, light, or to a pendulum, belong to what are known as *simple harmonic vibrations*. The characteristic of such vibrations is that they not only recur without variation at equal intervals of time, but that at each instant of the motion the displacement and velocity of each particle of the vibrating material follows a certain definite law.

Imagine a particle P to describe a circle with uniform velocity. Its projection N, on a fixed diameter, moves to and fro along that diameter with a velocity which is zero at each end and is a maximum at the centre. The motion of N constitutes a simple harmonic motion. Let T denote the time of a complete vibration—that is, the time taken by P in one revolution—a the radius of the circle or amplitude of the vibration. The displacement x at a time t is given by $x = a \sin \frac{2\pi t}{T}$. From this the velocity or acceleration is easily obtained.

If f denotes the frequency, then $x = a \sin 2\pi ft$. Let f_1 and f_2 denote two given or assumed frequencies, then for a numerical value of a two sine curves may be drawn. The resultant curve is found by adding corresponding ordinates. See Besant's *Hydrostatics*, page 188.

The process indicated is too long for insertion here, but this and similar problems will receive due attention at an early date in the columns of the *Practical Teacher*.

Redder.—Draw a triangle ABC having the vertical angle A large and the base BC horizontal. Let AB denote a rod connected by smooth hinges to a fixed point B, and to the end A of a rod AC whose other end C can move in a smooth groove BCD. The weight of the rods being negligible, a force F is applied in the plane ABC at right angles to AB at A. Find an expression for the force transmitted by the rod AC along the groove.

If AB begin to rotate about B in the plane ABC, compare the initial velocities of the points A and C.

(Inter. Science, London, 1900.)

The component of the force F along CA = F cos (A − 90°) = F sin A. Hence the component along CB is F sin A cos C, since the reaction of the groove is at right angles to BC, and therefore has no component along BC.

Let ω be the initial angular velocity of AB about B. The initial velocity of A is ω . AB in a direction along a line at right angles to AB. The velocity of A along CA is therefore ω . AB cos (A − 90°) = ω . AB sin A. Hence the velocity of C along CA = ω . AB sin A.

Let V be the resultant velocity of C, which is along CB. Therefore V cos C is the component velocity of C along CA. Hence V cos C = ωAB sin A. Therefore $V = \frac{\omega AB \sin A}{\cos C}$.

$$\text{Hence, } \frac{\text{initial velocity of A}}{\text{initial velocity of C}} = \frac{\omega AB}{\omega AB \frac{\sin A}{\cos C}} = \frac{\cos C}{\sin A}.$$

Ralpho.—If $\frac{a^3 + b^3 + c^3}{a^2 + b^2 + c^2} = \frac{a^2 + b^2 + c^2}{a + b + c}$, show that each of these fractions is equal to $\frac{a(b^2 + c^2) + b(c^2 + a^2) + c(a^2 + b^2)}{2(bc + ca + ab)}$.

$$\text{Since } \frac{a^2 + b^2 + c^2}{a + b + c} = \frac{a^3 + b^3 + c^3}{a^2 + b^2 + c^2}.$$

$$\therefore \frac{a^2 + b^2 + c^2}{a + b + c} \cdot \frac{a + b + c}{a + b + c} = \frac{a^3 + b^3 + c^3}{a^2 + b^2 + c^2}.$$

$$\therefore \frac{a^3 + b^3 + c^3 + a(b^2 + c^2) + b(c^2 + a^2) + c(a^2 + b^2)}{a^2 + b^2 + c^2 + 2(ab + bc + ca)} = \frac{a^3 + b^3 + c^3}{a^2 + b^2 + c^2}.$$

$$\therefore \frac{a^3 + b^3 + c^3 + a(b^2 + c^2) + b(c^2 + a^2) + c(a^2 + b^2) - (a^3 + b^3 + c^3)}{a^2 + b^2 + c^2 + 2(ab + bc + ca) - (a^2 + b^2 + c^2)} = \frac{a^3 + b^3 + c^3}{a^2 + b^2 + c^2}.$$

$$\therefore \frac{a(b^2 + c^2) + b(c^2 + a^2) + c(a^2 + b^2)}{2(ab + bc + ca)} = \frac{a^3 + b^3 + c^3}{a^2 + b^2 + c^2}.$$

$$\text{Hence } \frac{a^3 + b^3 + c^3}{a^2 + b^2 + c^2} = \frac{a^2 + b^2 + c^2}{a + b + c} = \frac{a(b^2 + c^2) + b(c^2 + a^2) + c(a^2 + b^2)}{2(bc + ca + ab)}.$$

The following solutions can be had on application:—*Bike, Arum, Syneros, Limbo, Lot.*

CONTINENTAL HOLIDAY COURSES, SUMMER 1903.—II.

Where held.	Date.	Fees.	Return Fares from London, 1st Class Steamer, 2nd Class Railway.	Lowest Cost of "Pension" per Day.	For further information address:	Principal Subjects, etc.	Important Details.
FRANCE—*continued.*							
Paris	Christmas and Easter holidays.	25 francs per week (Leçons pratiques de langue et de littérature française, 5s. a week, 5 lessons.)	As above.....	As above....	Monsieur Louis Jadot, Université Hall, Boulevard Saint Michel, 95; or W. G. Lipscomb, Esq., County High School, Isleworth.	Study of French in groups of three or four. Visits to places of interest in Paris; also lectures on Literature, Art, educational and social life of Paris.	Preparatory to summer courses of the Alliance Française, and to the examination for the certificate d'études françaises de l'Université de Paris.
Grenoble...	July 1-Oct. 31... (Holiday courses.) Other courses during the whole year.	40 francs for the first six weeks, and 10 for each subsequent fortnight, or 60 francs for the whole course.	Via Calais and Paris, £6, 16s. 6d. Paris to Grenoble, £2.	4 to 5 francs (possibly 3 francs 50 centimes).	Monsieur Marcel Reymond, 4 Place de la Constitution.	French Language and Literature; Elocution and Pronunciation; Phonetics. Special study of spoken language. History of Art. Political, social, economic aspects of France.	Visits will be made to places of interest in the mountains of Dauphiné. For foreigners of both sexes. Preparation for University Certificates.
Nancy	(*a*) During the academic year. (*b*) Holiday courses, July 1-October 31.	(*a*) 50 francs for the half-year, 70 francs for the whole year. (*b*) 40 francs for the first month, 10 francs for each following month—maximum, 60 francs.	Via Calais, £2, 14s. 6d. (single). Paris to Nancy and back, £2, 3s.	3 to 5 francs.	Monsieur Laurent, à l'Université. (Also Bureau gratuit de renseignements, 24 Rue des Carmes.)	French Language, Grammar, Phonetics, etc. Modern France (literature, art, history, political economy, institutions, law).	Preparation for the examinations of the Alliance Française and University Certificates. Excursions to the Vosges, and visits to industrial establishments.
Villerville-sur-Mer (near Trouville).	August 4-25.....	£2, 5s.; free examinations. Free Franco-English correspondence for a whole year.	About £2, 5s., via Havre.	5 francs.....	Monsieur L. Bascan, Rue Caponière, Caen. (Syllabus post free on application.)	Special course on Phonetics. Conversation. Composition. Elocution. Reading. Translation. French methods of teaching.	For foreigners of both sexes. Preparation for the examinations of the Alliance Française and French University degrees.
Caen	Easter Holidays, July 1-30, August 1-30. Other courses during the whole year.	£1 for one week, £1, 12s. two, £2, 4s. three, or £3 for one month.	First class, £2, 1s. 8d.; second class, £1, 11s. 8d., via Southampton and Havre; second class, 30s., via Southampton and Cherbourg.	4 to 6 francs.	M. Lebonois, 7 Rue Neuve-Bourg-l'Abbé, or Walter Robins, Esq., Wanstead Cottage, New Wanstead.	French Language and Literature. Political and social aspects of France. Special study of spoken language. Phonetics. Commercial Class.	For foreigners of both sexes. Excursions. Scholarships for August course. Examinations for Diplomas.
Lisieux	August 1-27.....	£1, 13s.	£1, 18s. ..... (second class).	35 to 40 francs a week.	M. Féquet, 12 Rue de Rouen, Lisieux, or Harry Hardy, Esq., High Street, Penistone, nr. Sheffield.	French Language and Literature. Phonetics. History of French Education.	Small conversation circles. Excursions to Trouville, Villers, Cabourg, Falaise.
Douai.....	August 3-17	£1, 1s.....	Six guineas are charged by the Catholic Association for the return railway fare and all accommodation at Douai for a fortnight.	—	Valentine M. Dunford, Esq., Hon. Sec., Catholic Association, 22 Paternoster Row, London, E.C.	French Language and Literature. History. Languages.	The classes are conducted by the professors of the College of St. Jean, at Douai, and are under the management of the Committee of the Catholic Association. They are specially intended for Catholic and other teachers of both sexes.
Bayeux....	August 1-24.....	£2, 2s., which entitles the student to attend all the classes of any one of the professors, and also all the evening lectures.	London via Southampton and Havre to Caen. Return, first class, £2, 1s. 8d.; second class, £1, 11s. 8d. Caen to Bayeux, second class fare, 1s. 8d.	4½ francs....	M. Godal, au Collège, Bayeux, or John A. Nichols, Stanley Mount, New Mills, Stockport.	Phonetics, Conversation, Pronunciation, History and Geography of Normandy and Brittany, French Literature and History, Historical explanation of the rules of Syntax, Versification.	For teachers of both sexes. The classes are divided into Elementary, Intermediate, and Advanced. Examination for Diplomas.

Note.—Programmes of most of these courses may be seen at the Board of Education Library, St. Stephen's House, Cannon Row, Whitehall, London, S.W.

The foregoing table of holiday courses for instruction in modern languages is only intended to serve as a guide to students in their application for further details; the particulars given should in all cases be verified by direct communication with the secretaries, whose names and addresses will be found in the sixth column.

The secretaries will generally supply applicants with a list of *pensions*, etc.; but the little handbook *Holiday Resorts*, issued by the Teachers' Guild,* will always be found useful and reliable. The excursions in connection with most of these courses are arranged as economically as possible, and afford excellent opportunities for acquiring useful and interesting information, as well as for practice in conversation.

No student should attend an *advanced* course who has not some knowledge of the spoken language in which the course will be delivered; and all who take part in the courses are strongly advised to avail themselves of opportunities of enjoying social intercourse with foreign students. Experience has shown that in many cases, through associating too exclusively with visitors of their own nationality, students have missed much of the advantage which they would otherwise have gained from the courses.

* 74 Gower Street, London (price 1s., per post 1s. 1d., to non-members). (See page 90.)

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

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SCHOLARSHIP COURSE FOR 1903.

Eighth Month—August.

(*N.B.*—I should be glad if students who intend to follow this course regularly would send their names and addresses to me.)

Work for the Month.

1. *Reading.* — Prepare carefully *Esmond*, Book II., chaps. xii.–xv.

The importance of good oral reading, which has always been pointed out in these columns, is now further emphasised by the proposal of the Board of Education to make reading a failing subject. As a general rule, young teachers do not read so well as they should. The cause is obvious—they trust pretty well entirely to *eye* reading, and neglect to give to the muscles of the throat, tongue, and lips that exercise which is imperatively necessary. As well might one expect to obtain proficiency in playing scales on a piano by looking at them, as expect to produce the proper intonation and modulation of the voice without assiduous practice. Regular practice before a competent critic should be taken every day.

2. *Repetition.*—The remarks above apply equally to this subject. In addition to being letter perfect, the candidate must learn to express the author's meaning by the gradations of tone and emphasis.

3. *Teaching.*—Chap. viii., *Scholarship School Management:* The Teaching of Grammar and Repetition.

Why is grammar taught in schools? What is the practical use of the immense amount of parsing and analysis which is done by the average student? These questions must certainly have occurred to any one who thinks about his work, and the answer lies in a correct appreciation of what grammar really is. In the first place, it is not the art of speaking and writing correctly, since many people do so who have practically no knowledge of the laws of grammar; and even if they have, they never bear their knowledge in mind when framing a sentence. Grammar does very little to help towards correct speech; that is acquired by listening to or reading correct language. A child talks as his associates talk, and lessons on grammar have very little effect upon him. Grammar is the science of language. The whole of the science consists in correct classification of words into parts of speech and their various subdivisions. To perform this operation correctly demands a certain train of reasoning. To take an example: a boy is parsing, and comes to the word "horse." He reasons: (1) The name of a thing is called a noun; (2) this is the name of a thing, (3) *therefore* this is a noun. This is reasoning by a syllogism. The value of grammar lies mainly in the fact that it supplies an infinite number of exercises in this abstract reasoning, and thus the mental faculty of reason and judgment is trained and developed. Bearing this in mind, it is obvious that every lesson must consist of this reasoning to be of any use, and a young teacher who provides the answer, instead of making the children find it out for themselves, is wasting time as far as any development of the class is concerned.

Hence every lesson must be given in steps, each step being an induction from suitable examples. For instance, suppose it is a first lesson in analysis, the steps would be—

(1.) The collection of suitable examples on the blackboard, as—Fishes swim, Birds sing, The man is at work.

(2.) Examination. By means of questions induce the fact that each sentence consists of two parts—(*a*) the thing spoken of; (*b*) what is said of it.

(3.) Classification. Take each sentence and let the class dissect it into the two parts.

(4.) Definition. Supply the terms subject and predicate, and educe the definitions—(*a*) the subject is the thing spoken of; (*b*) the predicate is what is said of the subject.

Every lesson should follow these lines.

The question naturally arises, Is there no other subject of greater practical utility which would lead to more valuable results? for it must be confessed that the ability to distinguish a factitive from a cognate object, though evidence of a certain amount of mental power, is in itself of no value whatever. Well, although no other subject affords quite so much material for pure reasoning, yet elementary science and nature study—*properly* taught, and this proviso is very necessary—afford a great scope for reasoning, and certainly the results arrived at are more valuable in themselves.

Repetition, as well as training the memory, provides a mental store of beautiful thought and expression which will last for a lifetime.

4. *Drawing.*—One or two copies each week. I still receive specimens for criticism lined in with a fine pointed pen on rough paper. I can only repeat to such students what I have said before—this is attempting an impossibility. The soft brush and sepia produce much better lines and effects. It is easier to vary the tone of the lines, and so prevent the copy from looking flat. I should also advise an occasional study from the plant or cast itself. The study of the former will amply repay the extra time spent upon it.

5. *Music.*—Translation from tonic sol-fa to old notation, and *vice versâ*. All students should learn the two systems together—the one assists the other so very much. Nelson's *Music for Pupil Teachers* takes the two systems concurrently.

6. *Penmanship.*—Ten minutes' daily practice from the *Practical Teacher Copy Book*. This is still a very weak subject with many students, because very little care is taken to study the curves and proportions. Marks are wilfully thrown away by not attending to these points.

7. *Composition.*—Write one or two essays each week on such subjects as:—

(*a*) The character of Touchstone.
(*b*) Secondary Education.
(*c*) Tennyson as a poet.
(*d*) "Sweet are the uses of adversity."
(*e*) "Whatsoever thy hand findeth to do, do it with thy might."
(*f*) The Lake poets.
(*g*) The character of James the First.
(*h*) Depression of trade in the West Indies.

Read up the subject if necessary. Analyse and classify ideas, and draw out a skeleton plan before commencing to write. The following notes may be of assistance:—

(*a*) Note the following points—(1) His wit as evidenced by his words and by the opinion of others; (2) his good nature; (3) his loyalty to Celia; (4) his lordly language to inferiors; (5) his keen insight into character. Quote lines to prove each point.

(*b*) Distinguish between primary and secondary—the one a continuation of the other, not a different character. Point out the importance of carrying education further than the limits prescribed by the annual Code. Suggest means by which this can be done. Compare, if you can, with American and Continental methods.

(*c*) To do this the student must have read Tennyson thoughtfully. The following points should be noted, with examples—(1) The music of his verse, (2) his happy choice of words, (3) his singularly appropriate metaphors, (4) his manliness.

(*d*) This should be easy. No character can be strong that has not felt the fire of adversity.

(*e*) Another easy subject. Instead of squandering effort on many things, concentrate all your power on one. Quote instances from history and literature.

(*f*) Your history of English literature will provide you with ample material.

(*g*) Read *The Fortunes of Nigel* (Scott) for an excellent and just appreciation.

(*h*) (1) Note that the prosperity of the West Indies depended upon the sugar trade. (2) Trace the effects of the abolition of slavery. (3) Point out the overwhelming competition of beet sugar (European and bounty fed). (4) Then explain the introduction of coolie labour and the growth and export of fruits.

8. *English.*—

(1.) Learn twenty-five roots and meanings per week.

(2.) Figures of speech.

(3.) *The Task*, Book V., lines 250-282.

(4.) *As You Like It*, Act III., Scene v.; Act IV., Scene i.

(5.) The writers of the first half of the nineteenth century.

Notes on English.

1. *Figures of Speech.*

Exact definitions and examples must be learned of:—Simile, metaphor, allegory, fable, parable, personification, antithesis, irony, epigram, metonymy, synecdoche, hyperbole, *litotes*, climax, anti-climax, apostrophe. The text-book should supply definitions, and the play and poem studied examples.

2. "*As You Like It.*"

Act III., Scene v.—The mingling of totally different characters—dukes, lords, shepherds, the fool, country girls, and high-born ladies—produces whimsical situations. In this scene a country girl, who evidently aspires higher than her station in life, promptly falls in love with Rosalind, whom she takes for a young man, despite the advice and scorn of Rosalind.

Falls not the axe. An example of an intransitive verb used transitively.

Atomies, minute specks.

Cicatrice, a mark: usually applied to the scar left by a wound on healing.

Without candle may go dark to bed, so small and unimportant that it does not need a light.

Sale-work, work made to be sold or disposed of; nothing very important.

'Od's my life. A slurred expression for "As God is my life." The disinclination to use the name of God has led to many such expressions—for example, "By Gad;" "Zounds" (by God's wounds), "'Sdeath" (by God's death).

Bugle, resembling a bugle, an elongated black glass bead.

Foggy south. The south wind brings moisture and rain to England.

Cry the man mercy, ask the man's pardon instead of insulting him.

Foul is most foul, etc. Ugliness is seen at its worst when, being ugly, it scoffs at others.

Dead shepherd—that is, Christopher Marlowe, killed in a drunken brawl in 1593. The lines are from his poem *Hero and Leander*. It is somewhat out of place for such a girl as Phebe to quote him.

I am sorry for thee, gentle Silvius. Note the change in her manner—the expression of sorrow and the use of the word *gentle*. Now that she is in love she can appreciate better his feelings.

Carlot, rustic (from the Middle English *carl*, a peasant).

Think not I love him, etc. Note the contradictions throughout this speech. One view is dictated by the mind, the other by the heart. She is trying to persuade herself that she has not fallen in love, although she is entirely conscious by her feelings that she *has*.

In parcels, in sections, bit by bit.

Am remembered, am reminded; similar to the French *je me souviens*.

Passing, surpassing, very.

Act IV., Scene i.—Jaques' melancholy is partly an affectation and partly the result of the consciousness of a wasted life, such as the duke hints at. He naturally fails entirely to convert a bright-spirited girl like Rosalind to his views. The dialogue between Rosalind and Orlando is particularly attractive. The peculiar position of the former allows her to say and do what in other garb she could not, although there is nothing unwomanly in her smart repartee. If Orlando had been a man of greater penetration, he must have seen that she was playing the game with too much zest and earnestness to be doing so for a mere pastime. He must have felt some magnetic attraction to the supposed youth, or he would not have entered so thoroughly into his part. The whole scene is an excellent example of the genius of Shakespeare in depicting human thought and action.

Scholar's melancholy, etc. The scholar's melancholy is the anxiety produced by constant competition with others; the musician's is a mere effort of fancy; the courtier's arises from the isolation he feels in his exalted position; the soldier's is the result of disappointed ambition; the lawyer's is merely assumed, to make the world think him overwhelmed with cases; and the lady's is the result of a fastidiousness which is always dissatisfied with her surroundings.

Lisp and wear strange suits, talk with an accent and dress in foreign style, as travellers used to do, to show that they had travelled.

Swan is a gondola—that is, been to Venice, the great resort of English travellers.

Clapped him on the shoulder, etc., may have encouraged him a little, but certainly did him no harm.

Leer, complexion. Celia interposes because she thinks the conversation is on rather dangerous ground. Rosalind's frank avowal, very sweet to her, was made in the belief that it would be taken as part of the game.

Gravelled, stuck, as a ship that has run on a bank.

When they are out, when they cannot think what to say.

Die by attorney, let some one else do it for you; don't do it yourself.

Videlicet, that is to say.

Troilus. She means "Troilus—an example of the constant lover—tried to die of grief at the loss of his mistress, but could not succeed. Leander is popularly supposed to have died of love, but it was really cramp which caused his drowning."

It will not kill a fly. Note how anxious Rosalind is that her lover should not entertain for a moment any suspicion of blemish in her character.

There a girl goes before the priest, there a girl answers before even the priest asks the question.

Against rain, when rain is coming. Birds show some excitement when the sky is becoming dark with storm clouds.

Diana in the fountain. The figure of Diana was a very common fountain piece.

Hyen, hyena, which is said to laugh; but the cry, though somewhat resembling hoarse laughter, does not arise from any mirth, but is rather a cry for food.

Make her fault her husband's occasion, make her own fault the opportunity of blaming and scolding her husband.

Bay of Portugal. This is really a deep part of the sea, and was in Shakespeare's time unfathomable.

Blind boy. Cupid, the god of love, is said to be blind, because people of such totally different stations and character fall in love with each other.

9. *Geography.*—(*a*) Australia; (*b*) revise thoroughly the remaining states of Africa. Pay especial attention to Somaliland. Somaliland is an ill-defined district to the south of the Gulf of Aden. It is a British protectorate, and is important as being on the route to India; but until recently no efforts have been made to assert British supremacy. Now, on account of a revolt under the Mullah, operations have been carried on, though not with much success, the army suffering from heat and drought. A caravan route passes through the country, and brings the produce of the interior down to the coast. The chief exports are coffee, hides, ostrich feathers, gums, and ivory.

In dealing with Australia, the student can hardly get a correct conception of its present position unless he reads up the history of the island continent, from the shipload of convicts which landed in 1788, to the establishment of the Commonwealth on 1st January 1901. The history throws an enormous light on the development of the various industries of the country.

Note.—The Commonwealth of Australia is a confederation of the six states—New South Wales, Victoria, Queensland, South Australia, West Australia, and Tasmania. The executive power is vested in the Sovereign (through a Governor-General) and an Executive Council of seven members. The central government consists of a Senate, composed of an equal number of senators (six) from each state, and a House of Representatives, elected by the people in proportion to the population. Each of the states has a local parliament, and these local parliaments decide what business is to be referred to the Commonwealth Parliament.

The capital has not yet been chosen, but it is to be in New South Wales (not within 100 miles of Sydney), since that is the oldest colony. There are five sites under consideration—Orange, Tumut, Lake George, Albury, and Bombala. Till the selection is made and the necessary buildings erected, the Parliament meets at Melbourne.

The Commonwealth has a revenue of about £11,500,000 a year.

The following table gives some of the most recent statistics and facts:—

State.	Area in Sq. Miles.	Population.	Productions.	Imports.	Exports.	Towns.
New S. Wales.	310,700	1,395,600	Gold, coal, copper, silver, lead, zinc, bismuth, tin, asbestos, platinum, wheat, maize, potato, sugar-cane, sheep, horses, and cattle.	Drapery and apparel, iron and steel goods, machinery, railway plant, spirits, paper, beer and ale.	Butter, copper, leather, frozen meat, tallow and wool.	Sydney, Newcastle, Broken Hill, Bathurst, Goulburn, Grafton, Paramatta, Albury.
Victoria.	87,884	1,200,914	Do., do.	Do., do.	Wool, gold, butter, wheat, oats, leather.	Melbourne, Ballarat, Bendigo, Geelong, Castlemaine.
South Australia.	903,690	362,604	Gold, copper, silver, lead, wheat, fruits (apples, pears, oranges, lemons, etc.), sheep and cattle.	Do., do.	Wool, copper, wheat, fruits.	Adelaide, Port Adelaide, Wallaroo, Port Augusta, Glenelg, Port Darwin.
Queensland.	668,497	510,515	Gold, copper, tin, lead, coal, fine timber, fruits.	Do., do.	Wool, gold, silver, tin, pearl and tortoise shell, oysters, bêche de mer, tallow, live stock.	Brisbane, Rockhampton, Maryborough, Townsville, Ipswich, Charters Towers, Gympie.
Tasmania.	26,215	174,233	Timber, fruits, tin.	Do., do.	Fruits, tin, mutton, tallow.	Hobart, Launceston, Zeehan, Ulverstone.
West Australia.	975,920	208,322	Gold, wool, timber, pearls, pearl shells, silver, lead, coal, iron, sandalwood. The chief gold-producing colony.	Do., do.	Wool, gold, jarrah, karri, tin, guano, sandalwood, pearls, kangaroo skins.	Perth, Fremantle, Albany, Geraldton, Coolgardie, Kalgoorlie, Southern Cross, Guildford.

10. *History.*—Charles the Second to Anne (1660–1714).

Pay special attention to these points:—

Charles the Second.—General policy of the king: selfishness. He ruled as arbitrarily as his father, but did so through ministers who had to bear the blame: for example, Clarendon, the Cabal, Danby, were in turn sacrificed to the popular indignation.

The Clarendon Code of laws against Dissenters, which increased rather than diminished their zeal. The Plague and Fire. The Dutch War: causes, events, and results. The Secret Treaty of Dover. The Triple Alliance. The Habeas Corpus Act, which put into practical effect the general recommendation of the Magna Charta. The bogus plot of Titus Oates and the Exclusion Bill.

James the Second.—Monmouth's and Argyle's rebellions; why did they fail? Attempts to re-introduce Catholicism: Declarations of Indulgence; Trial of the Seven Bishops. James had estranged the feelings of all classes: lawyers, by his interference with the legal procedure; the universities, by his attempts to force Catholics on them; the Church, by his attacks; the people, by the Bloody Assize of Jeffreys; and therefore he stood alone.

William the Third and Mary.—The Bill of Rights, hardly of less importance than Magna Charta; it definitely settled points on which monarchs and people had been at variance for centuries. Every item needs consideration. Reduction of Scotland and Ireland; Triennial Act; Toleration Act; Mutiny Act; William's foreign policy to curb the power of Louis the Fourteenth; French War; Peace of Ryswick.

Important constitutional changes arising out of the Revolution.

(1.) Government by party. William naturally put himself in the hands of the Whigs. The Cabinet was chosen from that body, and ministers became personally responsible for the work of their departments. The custom arose of the party with a majority in the Commons taking full control and responsibility for the Government, instead of, as in Stuart times, sheltering themselves behind the king's authority.

(2.) The commencement of a standing army, by the provisions of the Mutiny Act.

(3.) Appropriation of supplies. Money was granted for a definite purpose, and had to be used for that purpose only. Previously the king took all moneys and paid all accounts. Charles the Second allowed millions to dribble away which he could not account for. Now the king's income was fixed; also Parliament paid all other expenses.

(4.) The foundation of the National Debt and the Bank of England. William could not borrow on his personal security—(*a*) because his income was fixed; and (*b*) because his position was by no means secure.

Anne.—War of the Spanish Succession. The causes must be clearly understood. Learn periods of the chief battles. Treaty of Utrecht—exact terms. How far did England succeed in the objects for which she fought? The affair of Dr. Sacheverell. The people generally were dissatisfied with the Whig rule, and hailed with joy a chance to express their dissatisfaction. Result of the trial was to give the power into the hands of the Tories. Union with Scotland: this is *very* important. Note the causes and the exact terms of the union. Results of great benefit to Scotland.

11. *Arithmetic.*—Next 100 sums in the general examples (Christian and Collar). The theory and use of stocks. Students must write for assistance in individual sums which give them difficulty.

12. *Algebra.*—Indices. The theory must be carefully prepared. If this is understood, there is little difficulty in working the sums. Proofs of the following theorems must be learned:—

$$a^m \times a^n = a^{m+n};\ (a^m)^n = a^{mn};\ a^m \div a^n = a^{m-n};\ a^0 = 1;$$

$$a^{-1} = \frac{1}{a^{+1}}.$$

13. *Euclid.*—Finish Book II., with six deductions per week.

14. *Science.*—In Section 2 students have a choice of chemistry, astronomy, or biology. It will be probably found that the chemistry is easiest of preparation, especially if the student can work some of the experiments. For this month take chlorine, sulphur, and phosphorus.

Note for each:—Occurrence in nature (singly or combined); method of preparation; properties as proved by experiments; chief compounds and their qualities.

15. *General Information.*—Work one or two papers from the book of questions used.

Notes on the June Paper.

1. Fairly answered. Many students failed to explain how the movable type in a flat box came to be placed on a cylinder, though they generally stated that this was done. The process of stereotyping was entirely omitted.

2. The deductions concerning the weather from the facts supplied were very various. All candidates should understand cyclones and anticyclones. The weather indicated in this case is fine, with light winds, occasional showers.

3, 4, and 5. Generally correct.

6. The authors were generally given correctly, but many failed to give the synopsis of one of the books.

7. *Costa Rica* = rich coast. A term given by the Spaniards, probably from having seen the natives wear golden ornaments.

Philadelphia = the city of brotherly love. So named by Wm. Penn, the founder, to express his principles in dealing with the Indians.

Gloucester = Celtic, *Caer Glou*, or "Bright City;" Lat. *Glevum*. *Cester* denotes a camp there.

Laccadive = *Lakka dwipa*—the ten thousand isles.

Allahabad = the abode of God.

Cartagena = New Carthage, a settlement of the Carthaginians in Spain.

Naples = Gk. *Nea-polis* (the new city), a Greek colony.

The *Minch* probably means the Narrows; cognate with mince.

8. Mostly correct. The Corso is a fashionable drive in Rome. Many Italian towns have a racecourse or drive called the Corso or Course.

Test Questions on General Information.

The answers to these questions are marked gratis. They should be written on foolscap, and on one side only; the coupon of the present number and a stamped addressed envelope must be enclosed. All papers must be sent direct to Mr. A. T. Flux, Oakleigh, Belvedere, Kent. A prize of one guinea will be given

to the student securing the highest percentage of marks on the course.

1. Discuss the effects the teaching of Christianity has had on the world.

2. What is vivisection? Give arguments for and against.

3. What is a Pullman car; an Irish jaunting-car; a corridor train; narrow gauge?

4. What is meant by "hibernate"? Why do animals hibernate? What animals do so?

5. What figures of speech are used in the following?—

(*a*) Roll on, thou deep and dark blue ocean, roll!

(*b*) All hands on deck!

(*c*) Let not Ambition mock their useful toil.

(*d*) The pen is mightier than the sword.

(*e*) Footprints on the sands of time.

(*f*) I have ventured, like little wanton boys that swim on bladders.

(*g*) Myriads of rivulets hurrying o'er the lawn,
The murmur of innumerable bees.

6. Explain briefly Mr. Chamberlain's suggested alterations in our fiscal policy.

7. Point out the changes in meaning which the following words have undergone:—Presently, idiot, prevent, sincere, knave, charity, ostler.

8. Why do women wear their head-dress in church and men not? Why do women wear long hair and men not?

Test Questions.

1. *Penmanship.*
Large Hand.—*Terminology.*
Small Hand.—*What shall he have that killed the deer?*

2. How would you explain to a class the fact that when a quantity is divided by a fraction the result is greater than the divisor?

3. Write an essay on "The pen is mightier than the sword."

4. Analyse the following, and parse words in italics:—

(*a*) "Industry in some
To improve and cultivate their just demesne
Made *others covet what* they saw so *fair*."

(*b*) "Who so worthy *to control themselves*
As he whose prowess had subdued their foes."

5. How does Cowper account for the origin of kings?

6. Describe with a sketch-map Jamaica or British Guiana.

7. What is the Soudan? Give some account of its people and productions.

8. What were the causes which led to the civil war in 1642? How do you account for the Parliamentarians winning?

9. What part did the Scots take in the civil war, 1642–1651? Account for their apparent change of sides.

10. Work the following:—

(*a*) The true discount on £1327, 9s. 4½d. due two years hence is £86, 16s. 10½d. What is the rate per cent. simple interest?
Ans. 3½.

(*b*) Find the true discount on £5135 for 219 days at 4½ per cent. per annum. Explain how this differs from bankers' discount. Ans. £135.

(*c*) A man after a tour found he had spent every day half as many shillings as the total number of days he had been from home. He spent £57, 12s. 0d. How long was he away?
Ans. 48 days.

(*d*) If the difference between interest and discount on a sum of money for two months at 4½ per cent. be 2s. 3d., find the sum.
Ans. £2015.

11. What are the magnetic elements of any place?

PUPIL TEACHERS' COURSE.

For Candidates' Examination, 1904.

Work for the Month.

1. *Reading and Repetition.*—Oral practice is very necessary. Great care must be taken with the enunciation of the final consonant.

2. *Penmanship.*—Ten minutes' practice daily from the *Practical Teacher Copy Book*, and continual care.

3. *English.*—*The Elegy*, verses 13–16. Analyse and parse the whole. Learn the meaning of any allusions, and the derivations of the principal words.

The meaning of the four verses may be freely rendered thus:—

But they had had none of the advantages of education. All the stores of learning which had accumulated in bygone ages were entirely closed to them. Their life was a continual drudgery—a constant struggle for a bare livelihood, which occupied all their attention and effectually quenched any higher and nobler thoughts.

As the depths of the oceans must contain many a beautiful pearl which is unappreciated because unseen, as many a lovely flower attains its greatest beauty and then decays without ever being seen by human eyes, so with these men.

And yet there may have been one who withstood the petty tyranny of a master as boldly as Hampden did the illegal imposition of taxes, and at as great a risk to his freedom; another may have had all the makings of as great a poet as Milton; and another might have become a famous general.

But their position in life prevented them from acquiring the praise and admiration of men, from viewing the future with confidence, from being the means of ameliorating the lot of their fellow-countrymen by some wise act of legislation, and from learning, by the applause and admiration of the crowds which flocked to see them, that their names would go down in history as those of great men.

Note.—The whole of the verse "Th' applause.....eyes" is the object of *forbad* in the next verse.

4. *Arithmetic.*—Vulgar Fractions.

Learn exact definition of the various terms—Numerator, Denominator, Proper, Improper, Complex, Compound, etc.

Be prepared to prove the various simple processes by drawing diagrams.

Remember that when you get a sum with all the signs of addition, subtraction, multiplication, and division employed, you must work out all multiplication and division before adding or subtracting.

In working a complex fraction, avoid breaking the sum to pieces and working out little bits. The whole sum must be worked *downwards* in successive lines. Note the following method, and copy it *always*.

$$\frac{9\frac{1}{2} \div 6\frac{1}{3}}{9\frac{1}{2} - 6\frac{1}{3}} \div \frac{16\frac{1}{4} \div 11\frac{1}{4}}{16\frac{1}{4} + 11\frac{1}{4}} \times 17\frac{9}{14}$$

$$= \frac{\frac{19}{2} \div \frac{19}{3}}{\frac{19}{2} - \frac{19}{3}} \div \frac{\frac{135}{8} \div \frac{45}{4}}{\frac{135}{8} + \frac{45}{4}} \times \frac{247}{14}$$

$$= \frac{\frac{19}{2} \times \frac{3}{19}}{\frac{57 - 38}{6}} \div \frac{\frac{135}{8} \times \frac{4}{45}}{\frac{135 + 45}{8}} \times \frac{247}{14}$$

$$= \frac{\frac{3}{2}}{\frac{19}{6}} \div \frac{\frac{3}{2}}{\frac{225}{8}} \times \frac{247}{14}$$

$$= \frac{9}{19} \div \frac{12}{225} \times \frac{247}{14}$$

$$= \frac{9}{19} \times \frac{225}{12} \times \frac{247}{14}$$

$$= \frac{8875}{56} = 156\frac{19}{56}.$$

5. *Geography.*—The southern and midland counties in detail.

6. *History.*—Edward the Second, Edward the Third, Richard, and Henry the Fourth.

The text-book will supply all necessary information. Special attention should be given to the Battle of Bannockburn; the Hundred Years' War—its causes and battles; the Black Death; Statute of Labourers; the Peasants' Revolt—its causes and effects.

7. *Elementary Science.*—Parallelogram of forces. Composition and resolution of forces.

8. *Music.*—Accent. Two, three, and four pulse measures.

Questions on Last Month's Work.

1. Analyse the following, and parse words in italics:—
"Nor *you, ye proud, impute* to these the fault,
If *Memory* o'er their tomb *no* trophies *raise*,
Where through the long-drawn aisle and fretted vault
The pealing anthem swells the note of praise."

2. Write a short essay on insects and their use to man.

3. Work the following:—

(*a*) Find the G.C.M. and L.C.M. of 14938, 23474, 32010. Find the smallest sum of money which can be divided exactly into shares of £23, 16s. 8d. or £31, 3s. 4d.
Ans. 2134; 2464770; £405, 3s. 4d.

(*b*) What is the greatest number which, when used as the divisor of 68130 and 107275, will leave 27 and 49 respectively?
Ans. 1449.

(*c*) Thirty-three telegraph posts, placed at equal distances, extend a mile. How far apart are the posts? Ans. 55 yds.

(*d*) A farmer has 1134 sheep and 630 lambs. He forms them

into flocks, keeping them separate, and having the same number in each. If the flocks are as large as possible, how many are there in each? Ans. 126.

4. Draw a sketch-map of Norfolk, and say all you can about that county.

5. What do you know of the North Sea and its fisheries?

6. Say what you can of the Crusades.

7. Write a short life of Simon de Montfort, and give an account of his "Parliament."

8. How would you find the specific gravity of oil? A piece of stone weighs 16 lbs. in air and 12 in water. What is its specific gravity?

First Year.

1. *Reading and Repetition.*—Regular oral practice is very necessary.

2. *English.*—Cowper, *Expostulation*, lines 101–146; or *The Task*, Book V., lines 101–146.

Paraphrase and analyse the whole, and parse any word presenting difficulty. Write for any assistance required. Learn the derivation of all the important words.

3. *History.*—Edward the Second, Edward the Third, and Richard the Second.

Chief points:—

Edward the Second's favourites and their fates. The Battle of Bannockburn (learn a plan). The Lords Ordainers.

Edward the Third.—Hundred Years' War—causes. (Note that it was the desire of the king to assist the Flemish towns in revolt that led to the war. He did not claim the French crown till after the war had commenced, and then only to secure the allegiance and assistance of French noblemen who wanted a pretext to fight against the French king.) Learn plans of Crecy and Poitiers. The Black Death and Statute of Labourers.

Richard the Second.—The Peasants' Revolt is of the highest importance. The causes must be carefully traced:—Villenage, Black Death and Statute of Labourers, Wycliffe's teaching, discontent at the loss of French provinces, heavy taxation, heavy market tolls, and finally the poll-tax.

4. *Geography.*—Finish the countries of Europe. Draw plenty of sketch-maps for each, and repeat till thoroughly known.

5. *Arithmetic.*—Profit and loss. The explanation in text-book and the model examples must be carefully studied.

6. *Music.*—Work any back question.

7. *Science.*—Radiation. Reflection and refraction of light.

8. *Mathematics.*—Props. 9–14, and with two deductions per week.

9. *Algebra.*—Subtraction.

Test Questions.

1. Analyse one of the following, and parse the words in italics.

(*a*) "When nations are to perish in their sins,
'Tis in the church the leprosy begins.
The priest, whose office is, with zeal sincere,
To watch the fountain and preserve it clear,
Carelessly nods and sleeps upon the brink."

(*b*) "No frost *can* bind it there; its utmost force
Can but arrest the light and smoky mist
That in its fall the liquid sheet throws *wide*."

2. What is an interdict? Excommunication? What led to the signing of the Magna Charta?

3. What were Edward the First's chief legal reforms?

4. Give in the form of a table the states of the Balkan Peninsula, their capitals, chief productions, forms of government.

5. Describe a voyage round the coast from Gibraltar to Naples. Illustrate your answer by a sketch-map.

6. Work the following:—

(*a*) An agent is paid 2¾ per cent. on all the money he collects, and receives £57. How much did he collect?
Ans. £2072, 14s. 6⅔d.

(*b*) A warehouse contains goods worth £17,230, and is insured for 86·3 per cent. of its value. What would be lost in case of destruction by fire? Ans. £2360, 10s. 2¾d.

(*c*) For what sum should a ship worth £7250 be insured, at £3, 6s. 8d. per cent., so that the owner might recover, in case of loss, the value of the ship and insurance? Ans. £7500.

(*d*) Divide ten guineas between A and B so that ⅓ of A's portion may be equal to ¾ of B's. Ans. £6, 0s. 0d.; £4, 10s. 0d.

7. Show the importance in nature of the great specific capacity for heat of water.

Second Year.

1. *Reading and Repetition.*—Regular oral practice is very necessary. Neither subject can safely be neglected.

2. *Geography.*—The United States. Draw sketch-maps freely. Note particularly the river-basins, natural productions, railways, and the form of government.

The following questions have been asked:—

(1.) Describe the physical features of the United States.

(2.) Describe a coasting voyage from Boston to New Orleans.

(3.) Describe, with a sketch-map, the basin of the Mississippi.

(4.) Name some of the waterways and railways of the United States.

(5.) In what respects do the states bordering the Atlantic differ from those on the Pacific coast?

(6.) What are the chief productions, imports, and exports of the United States?

(7.) Name the races most numerous in the United States, and show how they are distributed.

(8.) Explain how the United States are governed.

(9.) Name the states bordering on the Gulf of Mexico; and describe Texas.

(10.) What do you know of New York, Chicago, San Francisco, St. Paul, Denver, Cincinnati, Boston, Washington, Brooklyn, Buffalo, St. Louis, Kansas City, Sierra Nevada, Colorado, Yosemite, Prairies, Long Island, Hudson River.

3. *History.*—George the First and George the Second.

Chief points:—George the First's descent and right to the throne. Riot Act. Rebellion of 1715. Septennial Act. South Sea Bubble. (Read this carefully. It is rarely understood. The cause of the disaster was the South Sea Company paying too high a price for the monopoly of trade, and making extravagant promises.) The Excise Bill. Porteous Riots. Walpole's methods of government. War with Spain. War of the Austrian Succession. (Note carefully the causes why we participated—chiefly the king's fear for Hanover.) The Rebellion of 1745. Reform of the Calendar—why necessary. The Seven Years' War. (Note causes—(1) In Europe, French joined Austria in attacking Frederick of Prussia, whom we supported; (2) in North America, the attempt of the French to ring in the English colonies with a line of forts; (3) in India, the rival interests of the French and English East India Companies.)

4. *English.*—Milton's *Paradise Lost*, Book III., lines 302–397. Make quite sure of meaning. Analysis and parsing. Learn derivation of the chief words.

5. *Arithmetic.*—Compound interest and stocks.

Work the former by the fractional method—that is, reduce the rate per cent. to the fraction of 100, and add the fraction of the principal for each year.

Stocks should present no difficulty. They are merely special cases of simple proportion. The terms, however, must be thoroughly understood. Write if any difficulty is experienced.

6. *Elementary Science.*—Preparation and properties of lime, silica, common salt, iron oxide, mercuric oxide.

Test Questions.

1. Write a short essay on Canada as a field for emigration.

2. Describe the course of the Canadian Pacific Railway, and point out its importance.

3. Describe, with a sketch-map, the State of British Columbia.

4. Point out some of the chief changes arising from the Revolution.

5. Describe, with a sketch-map, the battle of Blenheim.

6. Paraphrase *Paradise Lost*, Book III., lines 290–302.

7. Analyse and parse words in italics:—

"*As* in him perish all men, *so* in Thee,
As from a second root, shall be restored
As many as are restored; without Thee *none*.
His crime makes *guilty* all his sons."

8. Work the following:—

(*a*) What prime numbers divide 222222, and which is the least number that must be added to it, so that the sum may be divisible by 47, 53, or 59?
Ans. 2, 3, 7, 11, 13, 37; − 71, 716.

(*b*) A milk-dealer buys pure milk at 11½d. per gallon. How much water must he add to each gallon to enable him to sell it at 5d. per quart and realise 100 % profit? Ans. $\frac{1}{10}$ gal.

(*c*) How much is gained or lost per cent. by buying oranges at five for twopence and selling half at two a penny and half at three a penny? Ans. 4⅛ gain.

(*d*) A bill of £655, 10s., drawn on January 11 at 8 months, is discounted by a banker on April 14, at 4 per cent. What does the banker gain by deducting bankers' instead of real discount? Ans. 3·6$\frac{8}{17}$.

9. How would you prepare carbon dioxide for a class; and what experiments would you work to show its properties?

OUR CERTIFICATE COURSE FOR 1904.

BY GEORGE COLLAR, B.A., B.SC.,

Head-master of the Stockwell Pupil Teachers' School.

TEST QUESTIONS ON LAST MONTH'S WORK.

Theory of Teaching.

1. What is meant by school hygiene? State, without going into details—(*a*) The evil effects of bad ventilation; (*b*) the essentials of good ventilation; (*c*) the best mode of distributing light in the schoolroom. (Certificate, 1894.)

2. Discriminate between education and instruction. Under which would you place the inculcation of habits of punctuality? How is the responsibility for the latter divided between parent and teacher?

3. How does the obedience yielded by a child in school differ from the obedience of an adult to the obligations imposed by a "sense of duty," and how can the teacher develop the one into the other?

English Language and Literature.

1. Summarise the evidence which enables us to fix the date at which Shakespeare wrote the play of *Henry the Fifth*.

2. Give a list of historical inaccuracies in the play, and give short comments on them.

English History.

1. What material remains of the Roman occupation exist at the present day? Describe any rebellions against the Roman power in Britain.

2. Describe the social conditions of the people in Anglo-Saxon times.

Geography.

1. Where are Mont Cenis, the Eiger, the Michabel, Despoto Dagh, Piz Bernina, and Silva Plana?

2. Trace in detail the watershed which bounds the basin of the Rhine.

Arithmetic.

1. Define *number*, *unit*, *digit*, *subtraction*, and *multiplication*.

2. What are the advantages of teaching subtraction as "complementary addition"?

Euclid.

1. Construct a triangle, having given the base, the difference between the two sides, and the angle at the base opposite the smaller side. How would your construction be modified if the given angle were to be the one opposite the greater side?

2. The vertical angle ABC of a triangle is bisected by a straight line which cuts the base AC in D; show that AD is less than AB, and CD is less than CB.

3. If two triangles are upon the same base and have equal vertical angles, prove that the vertex of each triangle falls outside of the other triangle.

Elementary Science.

1. What illustrations would you employ in teaching children the differences between solids, liquids, and gases?

2. How would you illustrate to a class the passage of a substance from the solid to the liquid, and from the liquid to the gaseous condition? Mention substances which it is extremely difficult or impossible to alter in this way.

NOTES AND SYLLABUS FOR AUGUST.

English Composition.

Study Nesfield's *Senior Composition*, chaps. iv. and v., and work the exercises on them.

Prepare essays on the following subjects:—

1. "Studies serve for delight, for ornament, and for ability."
2. The Waverley Novels.
3. The power of public opinion.
4. The educational value of mountaineering.

Theory of Teaching.

Study Collar and Crook's *School Management*, chaps. v. and vi. The fifth chapter is very important, and should be read over and over again. If you can borrow a copy of H. Spencer's book on "Education," read it through to supplement this chapter.

With regard to notes of lessons, we cannot too strongly impress upon our readers the importance of acquiring a good form and style in preparing their notes. The notes written at the examination are highly marked, because they show not only the candidate's knowledge but also his teaching powers. The arrangement of notes in two columns, "Matter" and "Method" or "Treatment," is one that has been in use a long time, and which is often slavishly followed without any regard to the nature of the subject to be taught. If this vertical arrangement be adopted, it must be rigidly adhered to. Nothing but a statement of facts must appear in the "matter" column, and nothing but an indication of the way of teaching the subject must appear in the "treatment" column. Never put down the actual words of the questions you intend to put, and still less should you write down the answers you expect the children to give. Do not put information in the "treatment" column even when disguised in the form of a subordinate noun sentence—for example, "Tell the class that the sea is salt." Saltness should be enumerated among the properties of sea-water in the "matter" column, and opposite to it, in the "treatment" column, should appear the words "tell the class," or merely the word "exposition."

Much more important than this twofold vertical division of the notes is the indication of the five stages which every good lesson should follow, whatever be the form in which the notes are drawn up. The following are the "five points" which are now regarded as essential by every educationist.

1. *Preparation.*—This corresponds to what is often marked as "introduction." But it should be noted that while the preparation is an introduction to the subject, many an introduction is not a preparation for the lesson which is to come. Some teachers regard the introductory stage of a lesson as merely an opportunity for the children to guess the name of the subject of the lesson. A story is told of a pupil teacher who began by asking, "What does the hart do?" After rejecting the answers of children who thought he said "heart" instead of "hart," he quoted the verse, "As the hart pants after the waterbrooks," and required an answer in one word. When at last a boy said "Pants," he said, "Yes, 'pants.' Now, boys, we are going to have a lesson on 'trousers.'" Although we do not wish to imply that any of our readers are quite so bad as this, the story is certainly illustrative of many an "introduction" which is not a "preparation."

Now the most important point in the preparation is to call up to the children's minds the matter they have previously learned, and arrange it in such a way that it may best help in the acquisition of the new knowledge. We find that the impression made on the mind by the new matter presented to it depends mainly upon the ideas that are already in the mind, and the teacher's first duty is to marshal the old facts in such a way that they may help to seize the new. This relation between new matter and old is one of the most important discoveries in psychology from a teacher's point of view, and the student should carefully read the chapter on "Apperception" in Dexter and Garlick's *Psychology in the Schoolroom*.

2. *Presentation.*—Having prepared the minds of his pupils for the reception of what he has to teach, he next presents the new matter in the clearest possible way, using all illustrations necessary to make the children form a clear idea of individual facts. There must be frequent repetition and as much variety as possible, so that the matter may be looked at from several points of view.

3. *Association.*—In this step the relation of the things just taught to the things already known should be dwelt upon and generalisations drawn where possible; and as this is nearly always the case, some teachers call the third step *generalisation*.

4. *Formulation.*—In this step the children are required to crystallise their knowledge. This may be done by drawing up a definition, or by making a concise statement concerning the subject matter. Up to this point the children have been largely receptive; now they reproduce what they have learned. We need hardly say that lessons which begin with definitions are universally condemned, and the student who has followed us will see that to begin with a definition is a violation of the true principles of procedure.

5. *Application.*—The last step in the lesson consists in the application of what has been taught. In an arithmetic lesson or a grammar lesson, this naturally occupies a very important place, and perhaps the large amount of time allotted to the working of examples largely atones for failings in the other sections of the lessons. In no case should it be omitted. Children delight in *doing*, and seem to expect that a lesson should lead up to something for them to do.

It will be seen that a lesson drawn up on these lines follows

the course by which knowledge is acquired—namely, by careful examination of individual cases a general rule is drawn up, and then this law is tested by application to particular cases.

The most common error consists in trying to treat all subjects in precisely the same way. A history lesson requires more presentation and less application than an arithmetic lesson. Moreover, it frequently happens that we present, associate, and formulate parts of a lesson separately and give an application to the whole. Great scope is offered for discretion, and those who examine notes of lessons allow as much credit for the exercise of judgment as for anything else.

The following subjects are among those that have been set for notes of lessons at the Certificate Examination:—The use and abuse of object lessons. Wild flowers (*for infants*). Travelling. The sea. A transitive verb. The measurement of surfaces. Colours (*for infants*). The Spanish Armada. The art of printing. The parts of a house (*for infants*). Reduction to a common denominator. Fisheries. The manufacture of *either* iron *or* porcelain. Iron and steel (*for infants*). Greatest common measure. The mariner's compass. Words ending in *-tion*. Birds of passage. A carpenter's shop (*for infants*). Glaciers. The savings-bank. Some simple rules for preserving health. The use of metaphors. Plants used as food (*for infants*). A court of justice. A ship (*for infants*). Rain and snow. The sun. A mouse (*for infants*). Addition of vulgar fractions. The Chino-Japanese War. Good manners. Gibraltar bread (*for infants*). The planetary system. Westminster Abbey. The number twelve (*for infants*). Adjectives and adverbs.

It will be seen that in each set there is one lesson marked *for infants*. Of course it is open to any one to select this one; but we strongly advise all those who are not accustomed to the teaching of infants to leave that alone.

English Language and Literature.

Study the first act of *Henry the Fifth* in detail. Master all the allusions, learn the derivation of noteworthy words, and write down in your notebook and commit to memory any lines that serve to illustrate particular points, such as character or some special action.

Prologue, line 8. *Gentles*—that is, gentlemen and gentlewomen.

11. *Cockpit*, originally a small place in which cocks were set to fight.

30. *Turning.....an hourglass.* This may be regarded as an apology for the neglect of the "unity of time." Greek and Latin dramatists considered that their plays should be restricted by what are called the three unities. These are the unity of time, the unity of place, and the unity of action. The unity of time was a rule that originally forbade a play to represent events which took a longer time to happen than the play did to act, but later on it allowed a play to deal with events that did not take more than twenty-four hours to happen. The argument in favour of this was that it was absurd to bring a young person on to the stage in one act, and then a few minutes later show the same person advanced in life. The unity of place required that there should be no change of scene, but that all the events should happen or be described upon one spot. In early times there was no such elaborate scenery as we have in our modern theatres, but a board was hung up with an inscription announcing what the spectators were asked to imagine the stage to represent—"London: An antechamber in the king's palace." "The presence-chamber." "London: Before a tavern;" or "The English camp at Agincourt." In the absence of scenery to help the imagination, there was something to be said in favour of the observance of the unity of place. The unity of subject required that there should be no mixing of serious matter with comic; that a tragedy should be wholly serious and a comedy wholly comic. A play constructed in accordance with these rules was called a classical play, while one which paid no regard to them was called a romantic one. Ben Jonson's tragedies are classical; and the student will find a capital example in Milton's *Samson Agonistes*, the reading of which will impress him more with the characteristics of the two schools of drama than whole pages of description. The poet was seriously hampered by the three unities. He could not use one scene to represent the locality in which all he wished his play to deal with took place, unless he greatly restricted his incidents and action, or selected some courtyard of a palace and made the actors come on the stage and describe events that had happened elsewhere. The unity of time hampered him in precisely the same way. And since life itself is neither wholly grave nor wholly gay, the play which confined itself entirely to the one or the other was not lifelike. In our play the lighter element is supplied by Pistol, Nym, and Bardolph, and by the Welshman Fluellen. In France, tragedy remained under the rules of the three unities until 1828, when Victor Hugo pleaded for freedom in the preface to his play of *Cromwell*, which students who are sufficiently advanced in French should read.

Act I., Scene i., line 26. *Mortified.* Notice that this is the past participle = having been destroyed.

66. *Crescive*, growing, increasing (from Latin *cresco*, I grow). *His* = its. The form "its" is quite modern, and is not found in Shakespeare or the Bible.

Scene ii., line 143. *Coursing snatchers*, cattle lifters. Those who steal and run off with their booty. (Lat. *curro*, I run.)

151. *Hot assays*, violent attempts. *Assay* is really another form of *essay*.

155. *Feared*, frightened. Notice the subjective meaning. We should say "England feared Scotland," and Shakespeare really means that "Scotland has been feared by England."

227. *Almost kingly dukedoms.* The student must not think of France as a strong, united country such as it is now. Many of the French nobles were almost as powerful as the king, and owed him very little obedience.

The other points seem fully explained in the text-book; but readers are invited to write and send up difficulties.

English History.

Go to the end of the reign of Stephen. All the events centring round the Norman Conquest should be carefully studied, as associated in groups. Thus we have the rise in power of Godwin's family—(*a*) Establishment of himself and sons as governors of Wessex, Sussex, Kent, Essex, and East Anglia; (*b*) his influence as chief of the national party in resisting the influence of the Normans introduced at court; (*c*) the marriage of his daughter Editha to Edward; (*d*) death of Prince Edward and youth of his son Edgar Atheling.

The details of the Feudal System must be mastered. Too frequently the student's ideas are very one-sided, and in the relations between the lord and his vassal it is assumed that the lord derived various benefits from his vassal and conferred none in return. Among the benefits the vassal derived we may mention the use of the estate, protection from all wrongdoers (and the need of protection by some powerful warrior was so great during the troublesome times that followed the breaking up of the empire of Charlemagne, that many small landowners previously independent were glad to surrender their estates to a powerful neighbour and receive them back on the conditions of feudal tenure). It must be remembered that the fief was hereditary, subject to certain feudal dues, which were generally no heavier than the death or succession duties now paid to the state. The lord also was bound to administer justice in cases in which his vassal was involved.

The relations between church and state at this period require careful attention, as there was continual disagreement as to their respective powers, although some of the points were not settled until the reign of Henry the Second.

Geography.

Finish the physical features of Europe. Do not regard the rivers as mere streams of water draining the land. Rivers naturally run down the lowest parts of the valleys, which, indeed, they have formed; hence on the map the river teaches the direction of the valleys, and hence the trade routes. Observe how the great trade routes follow the courses of the valleys, and notice the points at which the route passes from one valley to another; hence the importance of such places as the Alpine passes and the mountain tunnels. Get rid of the idea that a river forms a good natural boundary. It is definite enough, but from its position with respect to the valleys it serves as the place where people are brought together. A range of mountains forms the best natural boundary between countries. On one side of a mountain chain we find people of different race from, and having very little in common with, the people on the other, but this is not the case with the two sides of a river.

Arithmetic.

Study carefully Christian and Collar's *Arithmetic*, chaps. xvii., xviii., and xix., which contain many very important matters connected with the theory of numbers and their relations to one another. If these chapters are thoroughly mastered, the power of dealing rapidly with most operations with numbers will have been acquired.

Algebra.

Finish revision of the four fundamental rules, and make quite sure of the theory.

Euclid.

Revise to the end of Book I.

Many students are able to prepare the book work, but are utterly at a loss when called up to do deductions. This is probably due to the unsystematic way in which deductions are taught. Deductions are generally worked as exercises on given propositions, and if the exercises were merely intended to drive the propositions home, there is nothing to be said against the plan of taking them in the order of the propositions on which they depend; but as a training in the logical process of deduction, the order is as unsound and illogical as possible. They might just as well be worked in the alphabetical order of their first words.

Having mastered the individual propositions, taking each as a deduction on its predecessors where possible, the student should classify them according to what they do or prove. Thus in the theorems we have:—

1. Those that prove two lines equal—4, 6, 26, 33, 34;
2. Those that prove two angles equal—4, 5, 8, 15, 26, 29, 34;

and so on. We will not complete the table, for that would deprive the student of the valuable exercise of drawing it up for himself. It would be more correct to call this a classification of the things proved by theorems than a classification of the theorems themselves, for Euclid frequently proves more than one thing in what is counted as one theorem. We might, for instance, regard the fourth and twenty-sixth propositions as each consisting of three theorems having a common hypothesis, and the twenty-eighth as consisting of two theorems having a common consequence. On this account the fourth and twenty-sixth appear in the list among those which prove two lines equal, and again among those which prove two angles equal, and further on they will appear again among those which prove two triangles equal.

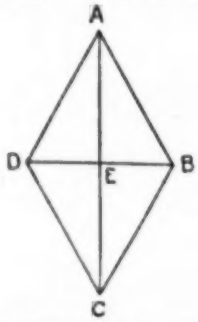
We shall now be able to graduate deductions according to their complexity. The first thing to ask is, What have we to prove?

Example 1. *The straight line which bisects the vertical angle of an isosceles triangle bisects also the base.*

Here we have to prove that two lines are equal to one another, and on thinking of our list we see that we must use either 4, 6, 26, 33, or 34. In order to be proved equal by I. 4, the lines must be the bases of two triangles which have two sides of one respectively equal to two sides of the other, and also have the included angles equal. On referring to our enunciation, we find that all these facts are given. Large numbers of deductions come out in one step like this, and we may for convenience call these "deductions of the first degree."

Example 2. *The diagonals of a rhombus bisect each other.*

Here we observe that we have to prove two lines equal to one another; hence, as before, we must use 4, 6, 26, 33, or 34. But on inquiring what are the conditions necessary for the use of each of these, we find that we have in no case sufficient material



given. The fourth is the nearest, for we have AD = AB (by definition), and AE is common; but we require also that angle DAE to be equal to the angle BAE, and this is not given to us. Therefore our deduction is not one of the first degree, for we cannot do it in one step. We must take a preliminary step and prove these angles equal. To prove angles equal we must use either 4, 5, 8, 15, 26, 29, or 34; and on thinking of the hypotheses in these cases we find that the eight is the most convenient, for we require the angles to be the vertical angles of two triangles which have their containing sides equal, and also their bases equal. Now these conditions are given in this deduction, for AD = AB, and AC is common, and the base DC = the base BC. Therefore the angle DAC = the angle BAC, and having proved this, we have all the conditions required by I. 4 to prove that DE is equal to EB.

It is convenient to describe a deduction that comes out like this one in two steps as a deduction of the second degree. Suppose that there had still been a condition wanting in order to prove the angle DAC equal to the angle BAC, then we should have had to take another step, and so the deduction would have been one of the third degree. But in every deduction that can be got out, if we only go on long enough, we shall at length find all we require in the enunciation.

It follows that all deductions might be classified as of the first, second, etc., degree, but the classification becomes less rigid as the number of degrees increases. At the same time it becomes less important, for many deductions may be used by the student as aids in proving others; for example, some question might arise over a figure similar to the one in Example 2, in which it would be necessary to prove DE equal to EB. The student who remembered that he had proved that the diagonals of a rhombus bisect one another would treat that as one step, although it would be set out in the examination paper in two.

If the student follows out these instructions, and applies our plan to his deductions, he will have done a good, useful month's work.

Elementary Science.

We have now to consider the general properties of bodies, and notice in which state the properties are most strongly shown.

Among the most notable properties of solids are *rigidity* and *elasticity*. Rigidity is essentially a property peculiar to the solid state, and may be defined as the property in virtue of which a body will keep its own form and volume unless acted upon by a considerable force. In theory we may speak of a "perfectly rigid body," but in practice no body has yet been discovered which will not yield to the action of some force or other at our disposal. Liquids and gases possess no rigidity whatever. Elasticity is the property which makes bodies tend to resume their original form and volume when they have been thrust out of them. Students often fall into the error of assuming that the body which will undergo the greatest change, provided it can recover itself afterwards, is the most elastic. Many bodies will undergo very little change of volume or shape although acted upon by a considerable force, but they recover with great energy. Well-tempered steel is much more elastic than india-rubber. Elasticity may be shown by bouncing. When a marble is dropped on a stone pavement, at the moment of contact the pavement is slightly compressed by the marble, and the marble is flattened by the pavement; then elasticity makes them recover their original forms with so much vigour that the marble is projected into the air again. In this case the marble undergoes far less alteration of shape than an india-rubber ball would, but it exerts a very great amount of force in recovering. Elasticity may be called into play by compression or by tension—that is, pulling—or by torsion, as shown by twisting a piece of wire, or by bending. Liquids can be made to show elasticity by compression and tension alone, and experiments on the elasticity of liquids are difficult to carry out; but since the passage of sound through a substance depends upon its elasticity, and sound does travel through liquids, we can prove that liquids are highly elastic although they are almost incompressible. Gases show their elasticity on compression or tension. A pop-gun is a very convenient little apparatus to illustrate this point. The rod is driven in, and so the air is compressed; the elastic force increases as the volume diminishes (Boyle's law), until at last it is sufficient to drive out the cork at the end, and the air makes a noise in escaping. A bicycle inflater is also a very useful article for showing the elasticity of the air. If the nozzle is closed while the handle is pressed down, the elastic force of the air is generally sufficient to drive the handle back almost to its original position.

The property of bodies in virtue of which they resist fracture. The more tenacious a body is the greater will be the force required to pull it asunder. Numerical results can be obtained by experimenting with wires of different material, but of the same gauge or diameter. A wire of lead is soon pulled asunder; copper wire requires much more force, and steel wire is far more tenacious still. Strange to say, certain organic fibres, such as silk and cotton, are even more tenacious than steel. We need not add that true liquids have no tenacity. Some are held together by a certain amount of force, and are said to be *viscous*. Gases, on the other hand, actually have a force which repels the particles from one another. Some solids, particularly the metals, show a sort of tenacity which enables them to be drawn out into thin wires or hammered or rolled into thin plates or sheets. These properties are called *ductility* and *malleability* respectively.

Brittleness is the opposite of tenacity, or rather of malleability, for a brittle substance breaks easily when struck.

OUR SCIENCE SECTION

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PHYSIOGRAPHY.

(ADVANCED AND HONOURS.)

Observations of Nova Geminorum.—Professor Barnard publishes in No. 5, Vol. xvii., of the *Astrophysical Journal* the results of his observations of Nova Geminorum. Most of these observations were made with the finders of the 40-inch and 12-inch refractors of the Yerkes Observatory.

During the first set of observations the Nova had a strong reddish colour, but this has since disappeared. Observations made in order to determine whether the light of this Nova exhibited the change of focus observed in the light of Nova Persei gave at first negative results; but careful observations made on 27th April indicated that the light of the Nova, when compared with that of an ordinary star, showed a difference of +0·08 inch (2·00 mm.) in focus.

The crimson image observed on 30th March had disappeared on 27th April, the out-of focus image of the Nova then resembling that of an ordinary star. Cloudy weather at Yerkes from 7th to 27th April prevented Professor Barnard from determining the exact date at which this change took place. The magnitude of the Nova is exhibiting the same periodical fluctuations as were observed in the case of Nova Persei.

The Red Spot on Jupiter.—In No. 3,875 of the *Astronomische Nachrichten*, Mr. Stanley J. Williams describes, and gives the detailed results of, his observations of the "great red spot" during the opposition of 1902.

Transit observations of the middle of the spot gave a rotational period of 9 h. 55 m. 39·55 s., and of the "following" end of the spot 9 h. 55 m. 39·88 s.; taking the weighted mean of these observations, Mr. Williams obtains, from 275 rotations, 9 h. 55 m. 39·66 s. as the result. This shows a further considerable acceleration of the rotational period of the red spot, amounting to 1·26 s., as compared with the result obtained during the opposition of 1901.—*Nature.*

International Balloon Ascents.—Twelve stations took part in the international scientific balloon ascents on the morning of 7th May, including Zürich and Bath, for the first time. The records for the latter station had not been found at the time of the publication of the preliminary results. The following are the most noteworthy of the unmanned ascents:—Strassburg, 13,400 metres: at 9,500 metres the temperature was −58·3° C.; above this height an inversion of temperature occurred. The reading at starting was 10·5°. At Berlin the balloon rose to 13,360 metres: temperature at 7,560 metres was −43°; at starting, 11·9°. At Vienna a temperature of −54·4° was recorded at 9,020 metres; at starting, 14·8°. At the first two places the ascents were made about 4 a.m., at Vienna about 7 a.m. Relatively high pressure prevailed over south-east Europe, and a large area of low pressure to the northward, with its centre (29·5 inches) over the North Sea.

Volcanic Disturbances.—Professor Pilsudski, in the *Electritshestvo* (Russian), recites the fact that in each case where volcanic disturbances have occurred in regions having submarine cables, earth currents of electricity have interrupted the working of the wires. He supports the theory that seismic disturbances are produced by subterranean disturbances, in which electricity is the main factor; in other words, that they are the result of electrical discharges between strata of good conductivity separated by other strata of negligible conductivity, such as granite and silica. The discharges of such earth condensers generate great quantities of gases and vapours, and these under great compression produce during expansion disturbances in the direction of less resistance—that is to say, radially toward the surface.

Experiments in Mountain Building.—At a recent meeting of the Geological Society, Lord Avebury gave an interesting address embodying the results of experiments recently made by him as to the influence of pressure in the formation of mountain chains. After an appreciative reference to the work of other investigators in this direction, Lord Avebury said he felt there was some incompleteness about their experiments, inasmuch as pressure was applied only in one direction. To remedy this, Mr. Horace Darwin had kindly constructed for him an apparatus, consisting of four beams of wood approximated by screws, which enabled him to obtain compression in two directions at right angles to each other. The space between the beams was 2 feet square and 9 inches deep. In this were placed pieces of baize separated by layers of sand. The working of the screw brought the beams nearer to each other, until the sand at the top was flattened against the plate-glass covering the apparatus. Casts were then made of the different layers of baize, and the results, exhibited on the table, showed that in the bottom layer the ridges were narrow, short, precipitous, and greatly broken up, becoming wider, longer, and less steep till the layer below the sand on the top was plateau-like. A second series of experiments, in which the conditions were slightly varied, gave similar results with respect to the difference between the folds in the upper and lower layers. In both series there was a marked tendency for the lines of folding to run at right angles to each other. Some discussion followed, in the course of which it was shown that the accentuation of the folds in the lower layers was exactly what was found in many places, and that the plateau-like formation on the top also occurred under natural conditions. Many suggestions were made as to varying the experiments by applying pressure on all sides by means of a constricting ring, and from below so as to simulate the effects of an up-thrust. It was also thought that interesting results would be obtained if the materials between the baize layers were of different degrees of plasticity. All the speakers agreed as to the high value of the experiments, and the chairman (Mr. E. T. Newton) said that all the Fellows looked forward with pleasure to the results of those experiments Lord Avebury would make in the future.

Rainfall and Waterflow in the Thames Valley—(Report by M. Fitzmaurice to L.C.C.).—"For the past twenty years there has been a decline over the Thames watershed of an annual average of nearly 2½ inches below the mean rainfall of 28·50 inches, as computed by the late Mr. Symons for the forty years 1850–89; and I may add that this diminution has become more accentuated during the last five years. This decline is reflected in the diminished flow of the river as gauged at Teddington Weir, the natural flow having fallen to an average of 1,110½ million gallons daily at the intakes for the twenty years, compared with 1,350 million gallons over the 1850–89 period, showing a loss to the river of 239½ million gallons per day. As the diminished rainfall of 2½ inches equals 105 million gallons per day (after making an allowance for evaporation, etc., of roughly 70 per cent.), and the above diminished flow of 239½ million gallons shows a difference from this of 134½ million gallons daily, it would appear as though the condition of the river was becoming more acute, inasmuch as more rainfall would be required year by year to produce the long-period average rate of flow; in fact, what this means is that the percentage of total rainfall which reaches the river is diminishing as well as the total rainfall itself. Of course, against these facts we have the possibility of a long series of wet years, which may bring back the state of affairs which existed on the average during the long period mentioned."

The fact that we are at present in a period of relatively low rainfall is, of course, well known, and as regards the Thames Basin, the following table is quoted, giving the average annual fall deduced from twenty-four well-distributed stations:—

Year.	Inches.	Year.	Inches.	Year.	Inches.	Year.	Inches.
1883	28·41	1888	28·45	1893	22·08	1898	22·07
1884	22·90	1889	25·65	1894	32·33	1899	24·78
1885	29·15	1890	22·81	1895	26·32	1900	27·88
1886	31·07	1891	33·31	1896	25·82	1901	23·47
1887	21·22	1892	23·02	1897	27·79	1902	21·91

Arctic Geology.—As the report on the geological observations made during the recent Polar expedition of the *Fram*, recently read before the Royal Geographical Society by Mr. P. Schei, of which we (*Nature*) have received a separate copy, is only a preliminary one, and the geological terms employed require some revision to make them intelligible to an English reader, a brief notice may suffice, though evidently the results will be very valuable. Under Captain Sverdrup's leadership, Ellesmere Land was crossed, part of its southern and its western coast was traced, with the corresponding side of Grinnell Land, and journeys were made round Axel Heiberg and Ringnes Islands. The collections obtained, which were often considerable, show that the region explored, with the newly-discovered islands, consists of formations which were known to occur on the two sides of Smith Sound, and on the long chain of islands extending on or near the seventy-fifth parallel from North Devon to Prince Patrick Island—namely, a foundation of crystalline Archæan rocks, largely granitoid, followed by sedimentaries, the oldest of which are of Cambrian age, the part immediately following the Archæan being occasionally, as might be expected, an arkose. In some places representatives of the Ordovician and Silurian occur, and, as in the other islands, Devonian and Carboniferous, including the representative limestone, are extensively developed. Mesozoic formations are represented, but apparently on no great scale; and large masses of sandstone, with lignites and shales, are identified by their plant fossils as Tertiary (Miocene, or perhaps rather earlier), as in Greenland. In parts of Ellesmere Land and Heiberg Island are various eruptive rocks, porphyrites and diabases, cutting the Archæan and the older sedimentaries. Basalts and dolerites occur in Grinnell Land intrusive in Mesozoic strata, and surface lavas and somewhat similar rocks overlie Carboniferous rocks in Heiberg Island. They are older than the Tertiary shale mentioned above. The region has occasionally been much faulted, and locally crushed up against a "horst" of Archæan rock. It has also been affected by earth movements of late date, indicated by raised beaches and marine terraces, which are at various elevations up to nearly 600 feet, and so prove that the land has risen. There are no large masses of inland ice or signs of glaciers having formerly been on a much more extensive scale than at present. This is probably due, at any rate partly, to a rather small precipitation.

Rainfall and Sunshine of June 1903:—

	Max. Shade. Deg.	Min. Deg.	Sunshine. Hours.	Rainfall. In.
Saturday	59	38	nil	0·56
Sunday	52	45	nil	0.72
Monday	51	48	nil	1·52
Tuesday	61	44	4·0	0·23
Wednesday	67	46	6·3	0·20
Thursday	60	43	3·6	0·27
Friday	58	46	nil	0·45

This gives the lamentable total of 3·95 in. of rain for seven days of summer weather, and only fourteen hours of sunshine, while the temperatures speak for themselves. Up to Thursday evening at six o'clock the rainfall for the month totalled 5·37 in., as compared with 4·07 in. for the thirty days of June 1879, which is the most recorded in the annals of the Meteorological Office, though the Greenwich observations, which go back sixty years, credit one June with 5·8 in. Adding the twenty-four hours' fall to the amount already given, we get a total of 5·82 in. for nineteen days of June.

CHEMISTRY.

(ADVANCED AND HONOURS.)

BY T. CARTWRIGHT, B.A., B.SC.

Remarks on Group II.—We often get queries concerning this troublesome group, hence the following note should be of especial service. To decide whether or not a yellowish-white precipitate is sulphur, it should be noted whether the precipitate filters through, and also whether it remains unchanged after boiling. If so, it may be set down as sulphur. Remembering that any oxidising agent present, either as reagent or original substance, will form water with the H of H_2S, and set free the sulphur, it is inevitable that the deposition of sulphur should be a common event. Such reducing bodies are nitric acid, sulphites, nitrites, chromates, chlorates, permanganates, and occurrence is so common as to make this reduction of the H_2S a thing to be expected almost with every analysis. The boiling, besides affording a clue to the composition of the suspected white precipitate, also converts stannic sulphide into brown stannous sulphide, which precipitates much more easily than the stannic salt. At the same time any arsenic present is converted into arsenious sulphide, which also is more readily precipitated than the arsenious sulphide.

Preparation of Carbides and Acetylides.—M. Henri Moissan has contributed a note to the French Academy of Sciences on the preparation of carbides and acetylene acetylides by the action of acetylene gas upon the hydrides of the alkalis and alkaline earths. At a temperature of 100° C., these hydrides react with acetylene, liberating hydrogen, and giving compounds of the type $C_2K_2.C_2H_2$, and $C_2Ca.C_2H_2$. These compounds, heated in a vacuum, dissociate readily into acetylene and the corresponding carbide, and hence present a new method for the preparation of the carbides at a low temperature. Neither methane nor ethylene react at 100° C. with these hydrides.

A Method of Extracting Copper from its Sulphide Ores (Gustave Gin).—Dissolved sulphurous acid possesses the known property of attacking oxide and carbonate of copper, forming an unstable sulphite of the binoxide, which is gradually transformed into a mixture of cuproso-cupric sulphite and sulphate, according to the reaction—

1. $3CuO + 3SO_2 = 3SO_3Cu.$
2. $3SO_3Cu + CuO = SO_3Cu_2,SO_3Cu + SO_4Cu.$
   (Cuproso-cupric sulphite. / Sulphate of copper.)

Cuproso-cupric sulphite is slightly soluble in water, but easily soluble in solutions of sulphurous acid or cupric sulphate.

On heating the solution to 180° (under a pressure of 10 kilogrammes) it loses sulphurous acid, while cupric sulphate and metallic copper are formed:—

3. $(SO_3Cu_2 + SO_3Cu) = 2Cu + SO_4Cu + SO_2.$

If we group the formulæ 1, 2, and 3 together we see that, taken altogether, the reactions correspond to $4CuO + 2SO_2 = 2Cu + 2SO_4Cu$; that is to say, that half the copper can be obtained in the metallic state, and the other half in the form of sulphate.

On the above principles I have devised a process for the treatment of copper ores, utilising the sulphuric acid produced by roasting them in such a manner that the active reagents may be extracted entirely from the ore itself and from the atmosphere.

The ore is roasted in such a manner that the whole of the sulphide of copper is transformed into binoxide or sulphate, and the whole of the iron into peroxide.

Then it is lixiviated methodically by means of a solution of sulphurous acid prepared in the ordinary manner. A saturated solution of cuproso-cupric sulphite and sulphate of copper is obtained, containing at the same time a certain proportion of sulphite and sulphate of protoxide of iron. The sulphite of the sesquioxide of iron in the presence of an excess of sulphurous acid is transformed according to the reaction, $SO_3,Fe_2O_3 + SO_2 = SO_4Fe + SO_3Fe$.

The saturated solution of the salts of copper and iron is pumped into a copper boiler, where it is heated up to 180°, by which it is expected a pressure of 10 kilogrammes is produced. At this temperature the sulphite and the ferrous sulphate are completely insoluble, and are precipitated. As for the cuproso-cupric sulphite, it is dissociated, and loses two-thirds of its copper in the metallic state, and at the same time sulphate of copper is formed.

The cloudy liquid is forced by its own pressure through a filter-press heated by steam circulating round the plates, an apparatus I patented some time ago for the mechanical separation of cupric and ferrous sulphates, but which could be replaced by any other arrangement for the filtration of solutions at a high temperature.

In this manner we obtain a solution of sulphate of copper which can be cemented or treated for crystallised sulphate, and a precipitate containing metallic copper, and sulphite and sulphate of the protoxide. This precipitate is washed with pure water, which becomes saturated with sulphate of protoxide of iron, which may be extracted by crystallisation.

The residual sulphite is then oxidised by moist air, and gives sulphate of the protoxide, which can be eliminated by a fresh washing, and there remains finally metallic copper of great purity, which is melted and run into ingots.—*Chemical News.*

The Action of Hydrogen on Sodium (A. Holt, jun.).—Pieces of sodium free from oil were placed in a nickel boat and heated in a combustion tube through which a slow current of

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pure dry hydrogen was passing. An ordinary small combustion furnace without top tiles was employed; and it was arranged so that, whilst the lower part of the tube was strongly heated, the upper portion was kept at a lower temperature in order that the hydride might condense on it. The hydride thus obtained consisted of colourless matted crystals, a hairy deposit not unlike cotton-wool, and a white powder deposited next to the glass. The hairy material was formed on and above the powder in front of the boat, whilst the crystals projected from the surface of the tube at either side of the boat.

The analysis was performed (1) by decomposing the hydride with dry, air free hydrogen chloride, collecting the hydrogen due to the reaction, and estimating the sodium chloride formed by titration with silver nitrate; (2) by decomposing the hydride with absolute alcohol, collecting the hydrogen evolved, and estimating the sodium in the alcoholic solution by titration with standard acid. The ratio of sodium to hydrogen showed that the hydride had the composition NaH, as already stated by Moissan.

The hydride was instantly decomposed by water, forming sodium hydroxide and hydrogen, this result also occurring in air after a few minutes; it was at once decomposed by hydrochloric acid, the decomposition being accompanied by flame and a detonation. The hydride was immediately attacked by nitric and sulphuric acids, hydrogen sulphide, and alcohol, but ether, benzene, and mercury were without action on it.

With phenol and ammonia, it reacts only when heated, forming sodium phenoxide and sodamide respectively.

Carbon dioxide, when perfectly dry, has no action on the hydride at the ordinary temperature, but on heating a reaction takes place with the formation of carbon and a carbonate. The partially dried gas reacts with the hydride at the ordinary temperature, yielding a formate and carbon. When heated with ferric oxide, the hydride gives a ferrate.

The combination of hydrogen with sodium appears to take place only when the latter is in a state of vapour; the sodium probably interacts only when it is partially monatomic.

Cementation of Steels (Léon Guillet).—The author's researches on the cementation of steel show—(1) That the rapidity of penetration of carbon into the steel depends on the temperature, the time, and the chemical reactions produced by the carbon; (2) the experiments made did not determine the solubility of the carbon in the iron, but they apparently established the fact that there is a preliminary state of equilibrium which is destroyed by the final operation; (3) by simple cementation certain steels containing nickel acquire the same hardness as carbon steels.

The Form in which Mercuric Iodide goes into Solution (D. Grenez).—The author shows that the vapours emitted by red quadratic mercuric iodide at temperatures below the transformation point (126° under atmospheric pressure) take the yellow orthorhombic form on condensation. He further investigates the form in which mercuric iodide goes into solution, and comes to the conclusion that the two changes of state of red mercuric iodide, either when volatilised or when dissolved, cause the body to be transformed into the unstable yellow variety, even when the transformation takes place at temperatures at which the red iodide is in its most stable state.

International Meeting of Chemists.—At this important meeting of chemists the following amongst other interesting subjects were discussed:—G. Lunge reviewed the state of the sulphuric acid manufacture in a very able paper, recommending water-sprays (not vapour) for the lead chambers, and reaction plate towers with artificial draught, and pointing to the great improvements lately effected in concentration apparatus. Kestner (Lille) described his lead ventilators for artificial draught. E. Hart (Easton, Pa.) reported on sulphuric acid in the United States since 1900, and D. Pennock (Syracuse, N.Y.) on the progress in the soda industry in the United States. G. Beilby (Glasgow) reviewed the position of the cyanide industry, pointing out that the actual plants could supply more than twice as much cyanide as is wanted. Synthetic cyanide processes were further discussed, in different sections, by F. Rössler, G. Erlwein, and A. Frank. The latter two spoke particularly on the Caro-Frank process taken up by Siemens and Halske. The carbides of barium and calcium bind nitrogen when powdered and heated, forming $CaCN_2$, which, on extraction with water, yields $(CN.NH_2)_2$, and on fusion with salt (soda was used for the barium compound which was first prepared) sodium cyanide. The calcium cyanamide can also be directly prepared in the electric furnace from lime, coal, and atmospheric nitrogen. Decomposed with water vapour under pressure ammonia results; the calcium cyanamide also gives off ammonia in the soil, and is used as manure under the name of Kalkstickstoff. J. Bueb (Dessau) explained the recovery of the cyanogen from illuminating gas.

A New Etching Fluid.—In the *Chemical News*, Mr. Wm. Ramsay, A.I.C., describes a new etching fluid, which, though devised for other purposes, is not necessarily confined to them. Speaking of the use of ammonia for etching on copper, he states that it finds a prominent place, but is liable to inequality, as its action depends on the absorption of atmospheric oxygen, so that if the object is deeply immersed the action is slow; if near the surface it is quick, but irregular. Mr. Ramsay sought to introduce oxygen by other means, and employed peroxide of hydrogen, the result being all that could be desired. The reaction takes place energetically, and is complete in from a few seconds to a few minutes, according to the strength of the mixture. He introduces the copper into more or less dilute ammonia, and gradually adds the peroxide with a pipette. Oxygen is at once evolved, and the etching takes place rapidly, evenly, and without any of the after-effects produced by long etching.

THE REPRESENTATION AND CALCULATION OF SURDS BY GEOMETRY.

BY A. PRATT, B.A., B.SC., F.R.A.S.

THIS branch of geometry is not only easy and interesting, but also very useful, especially in showing the connection between geometry and arithmetic. To obtain good results we must pay the greatest attention to accuracy in measurement, but we cannot be more accurate than our instruments will allow us; hence we must have good instruments. This remark especially applies to the ruler, which should be accurately divided into inches and tenths of an inch, and also into centimetres and millimetres.

To understand fully the theory of the methods adopted, only one proposition is really necessary.

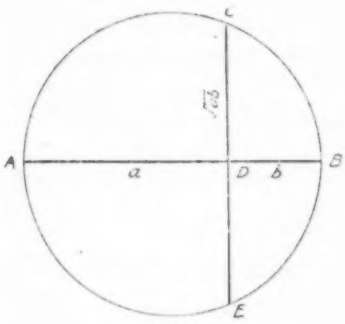

FIG. 1.

On AB describe a semicircle ABC; through any point D draw DC at right angles to AB; then $CD = \sqrt{AD \times DB}$, or CD is a mean proportion between AD and DB.

Proof:—Complete the circle and produce CD to E.

Then CD = DE (Euclid, III. 3).

Also CD . DE = AD . DB (Euclid, III. 35).

$\therefore$ CD . CD = AD . DB.

$\therefore$ $CD^2 = AD . DB$.

$\therefore$ $CD = \sqrt{AD . DB}$.

The same result may also be proved by proportion.

In Fig. 1, if AD is a cm. long, and DB is b cm. long, then CD will be $\sqrt{ab}$ cm. in length.

In the figure AD = 4 cm., DB = 2 cm., therefore $CD = \sqrt{8}$ cm. If then we take 1 cm. as our unit of length, we may say that the line CD contains $\sqrt{8}$ units, or simply $CD = \sqrt{8}$. Now measure CD carefully by a ruler graduated in centimetres and millimetres. We find that CD is a little more than 2·8 cm. long, therefore $\sqrt{8} = 2·8$ nearly. This is correct to the first decimal place, but we may obtain a higher degree of accuracy by estimating with the eye what fraction of a millimetre this excess really is. This excess is about ·3 of a millimetre—that is, ·03 of a centimetre, which gives as a result to the second place of decimals $\sqrt{8} = 2·83$. This result should be read off at once.

By arithmetic $\sqrt{8} = 2·828\ldots$

It is of great importance to choose a suitable unit. For small numbers 1", ·5", ·25", 1 cm. will be found convenient according to the space at our disposal. For large numbers ·1", ·01", 1 mm.

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may be used. The larger the unit the more accurate will be the result.

In working a problem the same unit must, of course, be kept throughout.

To calculate such surds as the following:—

(*a*) $\sqrt{5{\cdot}7}$, $\sqrt{11}$, $\sqrt{10{\cdot}75}$.

(*b*) $\sqrt[4]{5{\cdot}7}$, $\sqrt[4]{11}$, $\sqrt[4]{10{\cdot}75}$.

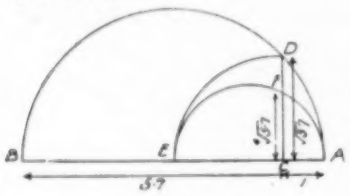

Fig. 2.

(*a*) $\sqrt{5{\cdot}7}$. Let our unit be 1 cm.

Draw a line of suitable length, and from it mark off AB = 6·7, AC = 1. On AB describe a semicircle. Through C draw by set square a line at right angles to AB, meeting the circumference in D.

Then $CD = \sqrt{5{\cdot}7 \times 1} = \sqrt{5{\cdot}7}$.

By measuring with ruler, we find that CD = 2·39 cm.

$\therefore \sqrt{5{\cdot}7} = 2{\cdot}39$.

By arithmetic $\sqrt{5{\cdot}7} = 2\,387$.

By a similar method we can find $\sqrt{11}$ and $\sqrt{10{\cdot}75}$.

(*b*) $\sqrt[4]{5{\cdot}7}$. Now the $\sqrt[4]{5{\cdot}7} = \sqrt{(\sqrt{5{\cdot}7})} = \sqrt{CD} = \sqrt{CD \times 1}$.

Hence we adopt the following method:—

With centre C and radius CD describe an arc cutting AB at E. On AE describe a semicircle cutting CD at F. Then $CF = \sqrt[4]{5{\cdot}7}$.

For $CF = \sqrt{EC \times AC} = \sqrt{CD \times AC} = \sqrt{\sqrt{5{\cdot}7} \times 1} = \sqrt[4]{5{\cdot}7}$.

Also CF = 1·53 cm. long—that is, $\sqrt[4]{5{\cdot}7} = 1{\cdot}53$.

By arithmetic $\sqrt[4]{5{\cdot}7} = 1{\cdot}54$.

By a repetition of this method we can obtain $\sqrt[8]{5{\cdot}7}$, $\sqrt[16]{5{\cdot}7}$, etc.

(*c*) $\sqrt{15}$, $\sqrt{35}$, $2\sqrt{3}$, $3\sqrt{2}$, etc.

If we wish to find the square root of a number like 15 which can be broken up into two factors, we have two methods at our disposal.

1. $\sqrt{15} = \sqrt{15 \times 1}$. We should make, as in Fig. 2, AC = 1 and CB = 15. Hence AB = 16.

2. $\sqrt{15} = \sqrt{3 \times 5}$. We should now make AC = 3 and CB = 5. Hence AB = 8.

By employing the second method, we not only have a much smaller figure, but we can also obtain a higher degree of accuracy in our result.

$2\sqrt{3}$. We may here find $\sqrt{3}$, and then multiply the result by 2; or, since $2\sqrt{3} = \sqrt{4 \times 3}$, we may obtain our answer without multiplying.

The second method is much more preferable, for we can find $\sqrt{12}$ quite as accurately as $\sqrt{3}$. Thus the error by the first method would be twice that of the second.

The same remark applies with equal force to the methods of obtaining the square root of a number in arithmetic.

(*d*) $\sqrt{4 + \sqrt{3}}$.

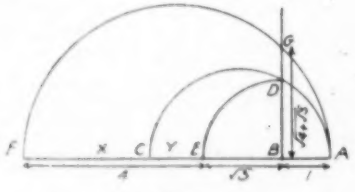

Fig. 3.

Unit = 1 cm.

From any line mark off AB = 1, BC = 3.

On AC describe a semicircle. Through B draw a line at right angles to AC, cutting the circumference at D. (This line should be produced, as it will afterwards be cut by a larger semicircle.) Then $BD = \sqrt{3}$.

With centre B and radius BD draw an arc cutting the line at E. Mark off EF = 4.

On AF describe a semicircle, cutting BD produced at G. Then $BG = \sqrt{4 + \sqrt{3}}$.

Proof:—$BE = BD = \sqrt{3}$, EF = 4. $\therefore BF = 4 + \sqrt{3}$.

$BG = \sqrt{BF \times AF} = \sqrt{(4 + \sqrt{3}) \times 1} = \sqrt{4 + \sqrt{3}}$.

BG = 2·4 cm. $\therefore \sqrt{4 + \sqrt{3}} = 2{\cdot}4$.

By arithmetic $\sqrt{4 + \sqrt{3}} = 2{\cdot}39\ldots$

On the same figure we may readily find $\sqrt[4]{4 + \sqrt{3}}$ by obtaining a mean proportion between BG and unity.

In evaluating a surd like $\sqrt{4 - \sqrt{3}}$, we adopt a similar method, with, however, a slight modification, owing to the negative sign. Mark off BX = 4, XY = $\sqrt{3}$, then BY = 4 − $\sqrt{3}$, and proceed in the usual way.

The following proposition is frequently used in finding the square root of a simple number. It has the advantage of using less space than the general method already described.

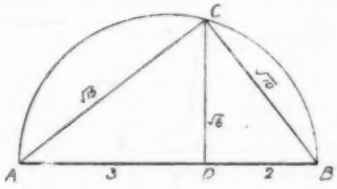

Fig. 4.

$AC = \sqrt{AB \cdot AD}$.

$BC = \sqrt{AB \cdot BD}$.

Proof:—$CD^2 = AD \cdot DB$.

$CD^2 + AD^2 = AD \cdot DB + AD^2$.

$AC^2 = AD(BD + AD) = AB \cdot AD$.

$\therefore AC = \sqrt{AB \cdot AD}$.

Similarly, $BC = \sqrt{AB \cdot BD}$.

If AD = 3, DB = 2, then $AC = \sqrt{15}$, $BC = \sqrt{10}$.

To obtain the $\sqrt{15}$ by this method a base line 5 units long is required.

To obtain the $\sqrt{15}$ by the method of Fig. 1, a base line at least 8 units long is required.

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In an introductory chapter on Experimental Geometry, the more important constructions which admit of graphical treatment are brought together, and this section cannot fail to be of the greatest use and value to those commencing the study of geometry. The remaining portions of the book, dealing with the more important parts of Euclid, will be readily understood. Although no attempt is made to follow Euclid's sequence, there is throughout the book constant reference to the various theorems and propositions. The numerous exercises have apparently been carefully selected. Altogether, the treatment of the subject is a great improvement on the older methods, and, as such, is sure to be well received by both teachers and students.

Elementary Geometry, Books IV.–VII. By W. M. Baker, M.A., and A. A. Bourne, M.A. The preceding work is not only published in complete form, containing Books I.–VII., but also in sections. For classes and schools these separate volumes will, no doubt, be of great use.

A. AND C. BLACK.

The British Empire Reader, IV. C. By L. W. Lyde, M.A. A geographical reader and a text-book on geography are two quite different things, and an author must make up his mind definitely to side with one or the other. And whichever he decides for, his difficulties are not slight. The writer of the *British Empire Reader* states in his preface that he has determined to leave gossipy subjects, such as peat-cutting and cider-making, for the teacher. This is, on the whole, a wise thing to do, though the plan must be carefully guarded, lest the book become bald and uninteresting. The book before us is an eminently readable book, though there are places where the writer might well have enlarged somewhat without trespassing on his plan. For instance, on p. 67, lines two and three, we are told that "nickel is very valuable to an empire which has such a large navy as the British." Here the writer might well have given a brief reference to the manufacture of steel plates for ships' armour. Again, on p. 134, last line, a few words on the mutiny of the *Bounty* might well have been inserted, especially as there is a blank half-page here. When mentioning the Matoppo Hills, on p. 162, a slight reference to the last resting-place of Cecil Rhodes, one of our Empire builders, would have been of interest to a British boy. The space required for these comments could have been secured by omitting unnecessary matter, as, for instance, on p. 7, par. 3. A scholar capable of appreciating a book of this type does not need to be told that "any small piece of land which juts out into the sea may be called a cape or head."

Most of the colonies have received excellent treatment, but we think Canada should have been dealt with more fully. The descriptions of Australia and the British West Indies are much more readable than those of Canada. On p. 67 the fur industry is dismissed in half a dozen lines, while the canning industry is barely mentioned.

The ninety-three illustrations are well selected, interesting, and appropriate, and set the book off, and the maps at the end are sufficient for their purpose.

The words in the bottom line of p. 56 need transposing, and on p. 46, line 3, the statement that Canada is nearly half the size of Europe needs correcting. The English on p. 21, par. 2, would perhaps be better if "would notice" were changed to "will have noticed;" and on p. 112, bottom line but one, "top of Port Phillip" would be better "at the head of Port Phillip."

The book is well printed, and should be a favourite reader.

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English Tales in Verse. With an introduction by C. H. Herford. This forms one of the volumes of the Warwick Library of English Literature, a collection of masterpieces of English literature arranged so that each volume deals with a special literary form. The volume of narrative poetry before us will prove a valuable book in pupil-teacher schools and secondary schools, where a difficulty is always felt in giving the pupils a taste for poetry. By presenting young students with poetry in which the subject-matter is more attractive than the form, we may hope to lead them up to the appreciation of poetry in which the sentiment and form are more important than the subject-matter. Among the poems contained in this book we may notice five from Chaucer, as well as others by Dryden, Crabbe, Wordsworth, and Keats, while *The Love of Alcestis*, by William Morris, completes the collection.

Professor Herford contributes a most scholarly essay on the subject of English narrative poetry, which forms the introduction to the book.

A Geography of Egypt and the Anglo-Egyptian Sudan. By H. W. Mardon, Tewfikieh Training College, Cairo. This book has been prepared to supply the needs of Egyptian schools, but it may well find a place in both primary and secondary schools in Great Britain. In the former it will be a useful geographical reader, and in the latter a capital book of reference for commercial examinations. The author has furnished an abundance of information of a highly interesting and useful

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character concerning a country about which, as a rule, little is to be found in English text books. The writer is an expert, and has had access at first hand to unusual sources of information. The chapters on "The Nile," "How the Land is Watered," "The Principal Crops," and "Manufacturing Industries," are of great interest, and would alone render the book valuable. These chapters have their value much enhanced by the excellent maps and illustrations of the recently finished barrage. The maps throughout the book are excellent, not overdone with colour, and really serviceable. Summaries of the chapters, in smaller type, are given for memorising, and there is an appendix containing trade tables.

The spelling of Sollum on the top of p. 10 differs from that in the map preceding. The diagram on p. 10, while very serviceable, might be rendered more striking to the eye by subdividing the larger area by dotted lines. At the bottom of p. 50, and in line 8, p. 52, millets is used instead of millet, the usual form in English books. While attention is drawn to historical points of interest, we would suggest a separate chapter for these in a future edition. Egypt contains so much that is historically attractive that we think British readers, at any rate, would enjoy a fuller account than has been given. We trust the book may receive a good welcome at British hands.

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CAMBRIDGE UNIVERSITY PRESS.

Solutions of the Examples in the "Elements of Hydrostatics." By S. L. Loney, M.A. A short time ago we had the opportunity, in these columns, to draw attention to the excellent volume on hydrostatics to which this is a key.

Those teachers and students who are familiar with the work referred to, and especially those who are working privately, will be glad to welcome the solutions to the examples. The work has evidently been carried out with great care and discrimination, and will furnish, where necessary, typical methods of solutions. In such a subject the teaching power of good numerical exercises is unquestionably very great, and those who use the book with judgment cannot fail to derive great benefit from it.

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Pottery. By Richard Lunn. A decidedly practical manual, which should be of great service to all students of this craft. After a brief historical introduction, Mr. Lunn deals fully with various technical processes—mould-making, decoration, firing, machinery, etc. In common with all Messrs. Chapman and Hall's publications, these books are very well produced.

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The Lord of the Isles. Edited by W. Keith Leask, M.A. A striking feature of this edition is the use of pictorial illustrations in both introduction and notes. These add greatly to its value. The life of Scott is admirably treated in the introduction, but the circumstances of the poem and the history connected with it are discussed somewhat more in detail than seems necessary. The text is beautifully printed, and the notes are well calculated to clear up all difficulties, though, in our opinion, these might be curtailed by leaving a little more to the intelligence of the student. "*Blent*," blended; "*dirge*," funeral note, for example, might be safely omitted. A very good glossary is added.

Pope's Essay on Criticism. Edited by B. M. Wantilove, M.A., Litt. D. This is an admirable little edition. There is first a short and interesting life of the poet. The text, as in all books issued by this firm, is very clearly printed, and the notes will prove specially helpful, and yet leave something to the reader's judgment. The book should have a ready sale.

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Die Harzreise. Edited by L. R. Gregor. Few German prose classics are so suitable for class reading as Heine's *Harzreise*, and the admirable introduction and valuable notes make this edition all that the teacher can desire. Without injury to the text a few expurgations have been made, so that the present text is suitable for students of any class. The volume also contains thirty-six pages of Heine's shorter poems. In a book so carefully edited it seems a pity to have to call attention to any faults, but we cannot understand the omission of the second verse of *In der Fremde*, page 109. The poem as printed is not even grammatical, for the third verse (here given as the second) is only a subordinate sentence dependent on the one omitted.

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Contes et Légendes. By H. A. Guerber. A well-selected set of stories, most of which are fresh to the schoolroom, taken from the folk-lore of different nations. There is a vocabulary, but as the book is intended to be used under the immediate supervision of a teacher, the notes are practically limited to a few footnotes giving the source from which the story has been obtained.

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The Education Acts, 1870–1902. By H. C. Richards, M.P., K.C., and Hy. Lynn of the Inner Temple, Barrister-at-Law. We have nothing but praise for this full and clear *vademecum* to the law on education as it now stands. The name of Hy. Lynn, standing counsel to the N.U.T., is sufficient guarantee for the teacher that what he wants to know will be found between the covers of this guide to the Act of 1902 and what preceded it; and a careful perusal of the pages has proved to us that this confidence is not in any degree misplaced. In every particular we found the manual as detailed as it is accurate.

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The matter, though necessarily broken, is interesting, well arranged, and, if backed up by good teaching and the ideas amplified, the book, which is meant to be a text-book and not a reader, will be of great service.

Geographies of the Continents: America. The design of this text-book is similar to the one reviewed above. It consists of sixty-three pages, and abounds in excellent maps and illustrations. Many geographical readers, far more pretentious and at five or six times the price, are not half so well illustrated. Perhaps in a future edition a map of the full course of the Canadian Pacific Railway will be given, instead of the part in the capital map on p. 20. The growing importance of this line, not for Canada only, but for the Empire, calls for its insertion in full in our text-books and atlases.

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Short Geography of the World. By George F. Bosworth. It is impossible for a small work of this character to be other than a book of facts. The world, taken country by country, is a large order, and the barest outline can be presented in such a small compass. The memory only can be served; there is not room for reasons, and the student asks almost in vain for the why and the wherefore. Opening the book at random, we find on p. 124, "The chief deserts of Africa are Sahara and Kalahari. The Sahara is the largest desert in the world, and is nearly as large as Europe. The Kalahari is the dry region of Bushman Land." Nothing is said as to the cause of these deserts. Again, on p. 18, "The climate of England is singularly temperate, far more so than that of other parts of the world in the same latitude," but no reasons are given for this.

Where there is not time for thorough and detailed study, the book will doubtless serve some good purposes, but we should have liked to see the book built on better educative lines.

Most of the maps are really good and serviceable; the poorest is that of Africa, on p. 125, from which little benefit can be derived.

Light for Students. By Edwin Edser. This will serve as a valuable text-book for students who wish to become acquainted with such an important subject as light. The first ten chapters deal with the laws of reflection and refraction, and the remaining portion of the book is devoted to the wave theory of light.

As pointed out in the preface, the limits of the book will not permit the inclusion of the electro-magnetic theory of light. This is to some extent unfortunate, as there are so many students who are very much interested in this section of the subject, and its omission tends to make the work to some extent incomplete. There is, however, ample information given, not only in the sections referred to, but also on many portions which do not usually find a place in books of a similar scope, such as the investigation of the velocity of transverse waves in an elastic solid, Lollmeier's theory of dispersion, etc. As no knowledge of the calculus is assumed, even those students whose mathematical knowledge is only of an elementary kind can profit by its perusal. Usually the consideration of such problems involves the use of somewhat advanced mathematical methods; but there are a large number of earnest students who are not able to use such methods, hence a book of this kind, in which the mathematics are only elementary (no knowledge of the calculus being assumed), will be of the greatest value to such readers.

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Teacher's Handbook of Manual Training: Metal-Work. By J. S. Miller. This volume, as its name implies, is primarily intended for the use of teachers, and consists of notes of lessons on metal-plate working, together with the manufacturing processes involved in the production of iron, steel, and alloys. The descriptions are, as a rule, very well expressed. Exception may, perhaps, be taken to the following, which occurs in detailing the foundry processes of making a casting: "The castings are made in a mixture of sand and loam, which is held in place by two metal *flasks*." The word "flasks" will fail to give any adequate idea of the form of the small or large cast-iron boxes used for the purpose. On p. 35 a rather crude diagram of a fly-press is given, and in describing its action the statement is made that "the ball is simply a weight which gives additional power to the lever." It would be possible to describe the use of the ball in a less misleading way than this.

These are, however, minor matters. Teachers will find much that is useful and suggestive in the various lessons throughout the book.

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